STAR

Scientific and Technical Aerospace Reports

A SEMIMONTHLY ABSTRACT JOURNAL WITH

MARCH 23, 1968

VOLUME 6 • NUMBER 6

N68-15006—N68-16105

DOCUMENTS DEPT.

APR 1 1968

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UNITED STATES GOVERNMENT
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
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Scientific and Technical Aerospace Reports, Volume 6, is prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Documentation Incorporated.

Use of funds for printing this publication approved by the Director of the Bureau of the Budget June 7, 1966.

Introduction

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts* is issued in coordination with *STAR*. Each journal appears on alternate weeks. *IAA* uses subject categories identical with those in *STAR*, and publishes similar indexes. *IAA's* worldwide coverage of books and scientific and trade journals complements *STAR's* worldwide report coverage. The two publications thus provide comprehensive access to current literature on aerospace science and technology.

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INDEXING VOCABULARY

The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is being used as the authority for the indexing vocabulary that appears in the subject index to this issue. The terminology has been modified from the *Guide to the Subject Indexes for STAR* (NASA SP-7016), the authority used for the vocabulary to indexes published prior to 1968. The *NASA Thesaurus* should be consulted for a total picture of the current indexing vocabulary including associated cross reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the Clearinghouse for Federal Scientific and Technical Information or the U. S. Government Printing Office at a price of $8.50 for the three-volume set.

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02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics. **765**

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems. **767**

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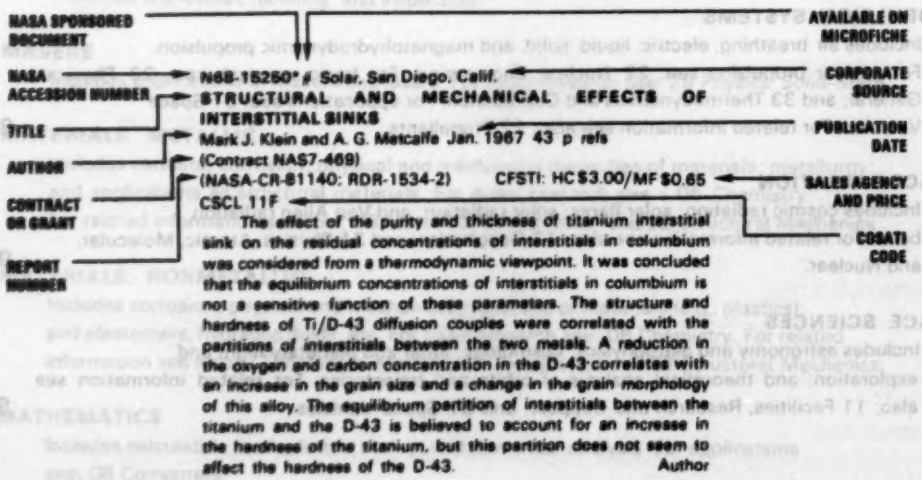
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N68-15250* # Solar, San Diego, Calif.
STRUCTURAL AND MECHANICAL EFFECTS OF INTERSTITIAL SINKS
Mark J. Klein and A. G. Metcalfe Jan. 1967 43 p refs
(Contract NAS7-469)
(NASA-CR-81140; RDR-1534-2) CFSTI: HC $3.00/MF $0.65
CSCL 11F
The effect of the purity and thickness of titanium interstitial sink on the residual concentrations of interstitials in columbium was considered from a thermodynamic viewpoint. It was concluded that the equilibrium concentrations of interstitials in columbium is not a sensitive function of these parameters. The structure and hardness of Ti/D-43 diffusion couples were correlated with the partitions of interstitials between the two metals. A reduction in the oxygen and carbon concentration in the D-43 correlates with an increase in the grain size and a change in the grain morphology of this alloy. The equilibrium partition of interstitials between the titanium and the D-43 is believed to account for an increase in the hardness of the titanium, but this partition does not seem to affect the hardness of the D-43. Author

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Scientific and Technical Aerospace Reports

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01 AERODYNAMICS

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N68-15185 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.

EXPERIMENTAL INVESTIGATION ON FLOW OPTIMIZATION IN HIGH TURNING DECELERATING BLADES BY MEANS OF AXIAL VELOCITY VARIATION

O. Scrofani Nov. 1966 28 p refs

(VKI-IN-19)

A method is described for cascade flow analysis in presence of gradual increase of the axial velocity from the inlet to the outlet of the cascade without modification of the blades but by shaping of the cascade walls. A singularity method is presented for determining the shape of the walls of highly cambered profiles to improve velocity distributions on the profile. The cascade is then tested in the configuration and particular attention is paid to the effects of the shaped wall on secondary flow. The method discussed shows the influence of the variation of the flow axial velocity, determined by a section variation, in a cascade of blades. B.S.D.

N68-15192# Aeronautical Research Council (Gt. Brit.)

ON WING–BODY INTERACTION AT SUPERSONIC SPEEDS 2

K. Stewartson (Univ. Coll., London) 13 Jan. 1967 17 p refs

(ARC-28682) CFSTI: HC $3.00/MF $0.65

The shape of the pressure curve on the root chord of a wing, extending symmetrically from a fuselage of circular cylindrical cross-section and near its leading edge, has been calculated. The wing is assumed to have nonzero thickness and can be at incidence.

Author (ESRO)

N68-15218# Institut Franco-Allemand de Recherches, St. Louis (France).

DETERMINATION OF THE FORM OF A SWEPT-BACK TYPE PROJECTILE [DEFINITION DE LA FORME D'UN PROJECTILE DU TYPE FLECHE]

J. B. Noyere and M. Giraud 21 Dec. 1966 20 p refs In FRENCH

(ISL-T-34/66)

Ballistic properties of fin-stabilized projectiles were determined in shock tunnel trials for 10 mm to 20 mm caliber ammunition. Theoretical criteria for optimal shaping, projectile fabrication, and projectile test evaluation showed that precision, stability, and trajectory lengths are of decisive importance in forming the projectile ballistics.

Author

N68-15219# Institut Franco-Allemand de Recherches, St. Louis (France).

SWEPT-BACK TYPE PROJECTILES. MANUFACTURE AND PRELIMINARY TESTS [PROJECTILES DU TYPE FLECHE. REALISATION ET ESSAIS PREPARATOIRES]

M. Giraud 21 Jul. 1967 33 p refs In FRENCH

(Contract DTAT-896.009/70)

(ISL-T-25/67)

The test evaluation of an 18.5 mm long fin-stabilized projectile in a free flight test range showed a medium velocity decrease of 0.13 m/s per meter flight distance. At an initial velocity of 1000 m/s, the projectile stability remained high with a maximal deflection angle of less than 2° at 130 m distance from the gun muzzle.

Author

N68-15615# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ROTATIONAL MOTION OF A SPHERICAL SATELLITE UNDER THE ACTION OF RETARDING AERODYNAMIC MOMENTS [O VRASHCHATEL'NOM DVIZHENII SHAROVOGO SPUTNIKA PRI DEYSTVII TORMOZYASHCHIKH AERODINAMICHESKIKH MOMENTOV]

Nam Tum Po *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 173–180 refs (See N68-15601 06-23)

The effect of the aerodynamic moments on the rotational motion of a spherical satellite relative to the center of inertia was considered analytically. The center of mass of the sphere is assumed to be at its geometric center. The sphere is assumed to move in a rarefied atmosphere in the 200–250 km altitude range where molecular collisions with the sphere surface are assumed to diffuse. Results indicate that the effect of the center of mass on retardation of the satellite is great if the satellite has a small mass and a large radius.

L.S.

N68-15616# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF DAMPING AERODYNAMIC MOMENT BY THE METHOD OF TWO-STAGE UNDAMPED OSCILLATIONS [OPREHELENIYE DEMPFIRUYUSHCHEGO AERODINAMICHESKOGO MOMENTA METODOM DVUKHSTEPENNYKH NEYATUKHAYUSHCHIKH KOLEBANIY]

V. B. Petrushin *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 181–193 ref (See N68-15601 06-23)

The aerodynamic damping moment is investigated theoretically and experimentally by means of the method of free and forced oscillations of a body moving across a gas flow in an aerodynamic tunnel. An experimental set up is described in which the damping moment coefficient is balanced by the static mass coefficient. The dependence of the damping moment and the static mass coefficients on the location of the center of rotation on the longitudinal axis is given in graphical form. The influence of the control surface dimensions on the damping moment coefficient is evaluated. On the basis of the tests performed, it is concluded that the independence of the aerodynamic coefficients from the type of motion observed in an ideal incompressible medium also holds in a real viscous medium. Author

N68-15685# Massachusetts Inst. of Tech., Cambridge. Aerophysics Lab.

VORTEX SEPARATION OF SLENDER BODIES OF ELLIPTIC CROSS SECTION

Leon H. Schindel and Thomas E. Chamberlain Aug. 1967 188 p refs

(Contract N600(19)-65138)

(MIT-TR-138; AD-662689)

The lift on slender bodies at high angle of attack is strongly influenced by the separation of a pair of vortices from the lee side. An analytical model of the vortex separation was developed which predicts the vortex development and the consequent nonlinear lift distribution on bodies of elliptic cross section and very general longitudinal contour. The report describes comparisons of the theory with subsonic wind tunnel tests on families of body shapes. Nose contours included pointed ogives, blunt ogives, and hemispheres. Body fineness ratios from 4 to 15 were tested and cross sections from circular to 3.5:1 ellipses. In addition the elliptic bodies were tested with major axes in and normal to the pitch plane. All cases were run with and without boundary layer trips at angle of attack up to 28 degrees. Vortex trajectories, obtained from the behavior of tuft grids, were in general agreement with theory. Normal force and pitching moment predictions also agreed with experiment until the theory failed at high angles of attack. Limitations on the validity of the analysis were thus experimentally established. The predicted locations of separation were generally quite far around to leeward from the positions measured by a China clay technique. Author (TAB)

N68-15688# Aeronautical Research Council (Gt. Brit.).

TESTS WITH A TWO-DIMENSIONAL INTAKE HAVING ALL-EXTERNAL COMPRESSION AND A DESIGN MACH NUMBER OF 2.0

M. C. Neale and P. S. Lamb London HMSO 1967 35 p refs Supersedes NGTE-M-368; ARC-25544 See N68-80755

(ARC-CP-937; NGTE-M.-368; ARC-25544) CFSTI: HC $3.00/MF $0.65

Results are reported of tests on a two-dimensional external compression intake having a design Mach number of 2.0. A pressure recovery of 93 per cent was measured with 3.3 per cent bleed from the ramp surface at the throat. The introduction of a small contraction in the throat improved the stable sub-critical margin of the intake. The test Reynolds number based on free stream conditions and intake capture height was approximately 1×10^6. Author (ESRO)

N68-15713# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN APPROXIMATE METHOD FOR CALCULATING THE PARAMETERS OF A DETACHED BOW WAVE [PRIBLIZHENNYY METOD RASCHETA PARAMETROV OTSOYEDINENNOY GOLOVNOY VOLNY]

Yu. I. Klimnyuk and A. P. Komarov 4 Aug. 1967 17 p refs Transl. into ENGLISH from Izv. Vyssh. Uchab. Zaved., Aviats. Tekh. (Kazan), no. 4, 1966 p 81–89

(FTD-HT-23-837-67; AD-662768)

The paper presents a simplified approximate method for determining the distance between a bow wave front and the nose of the body in supersonic flow, also the additional wave drag due to the formation of the bow wave. This method is a variation of Vinogradovs method and makes it possible to introduce a series of universal relations between the distance from the sonic point to the origin of the bow wave along the x-axis and the ordinate of the sonic point, which substantially simplify calculations and exclude the use of successive approximations. Using the ordinate of the sonic point as a characteristic dimension, all the parameters of the bow shock wave are determined irrespective of the body shape. This technique is shown to be applicable to supersonic axisymmetric and one-dimensional flows over blunted bodies at zero angle of attack when the bow wave is approximated by the equation of hyperbola and under certain simplifying assumptions. The results show good agreement with experimental data and also with data obtained from precise calculations by Belotserkovskys method. Author (TAB)

N68-15738# National Physical Lab., Teddington (England). Aerodynamics Div.

AN ALGOL PROGRAM FOR CALCULATING THE INVISCID PRESSURE DISTRIBUTION ON AEROFOILS BY THE WEBER–KUECHEMANN METHOD

J. Bridgewater and M. D. Whitley 18 Jul. 1967 29 p refs

(NPL-AERO-NOTE-1062; ARC-29291) CFSTI: HC $3.00/MF $0.65

A detailed description is given of a well tested ALGOL computer program for calculating the inviscid subsonic pressure distribution over two-dimensional and 'infinite sheared' aerofoil sections. Sufficient but brief information on the associated Weber–Kuechemann aerodynamic theory is also presented; and representative selections of test cases calculated by the program are compared with experimental results and those obtained from other theories. Agreement is found to be good provided the limitations stated in the text are adhered to. Author (ESRO)

N68-15739# National Physical Lab., Teddington (England). Aerodynamics Div.

THE ESTIMATION OF ZERO INCIDENCE FOREBODY PRESSURE DRAG COEFFICIENTS OF AXISYMMETRIC BODIES FROM MEASURED BOW SHOCK WAVES

P. G. Pugh and L. C. Ward 16 Aug. 1967 19 p refs

(NPL-AERO-1245; ARC-29350) CFSTI: HC $3.00/MF $0.65

The total drag of a body is linked with the total rate of entropy production in the whole flow field via Oswaititsch's theorem. This concept can be extended to relate entropy production at the bow shock-wave to forebody pressure drag. It is shown that this relationship can be used to provide reasonably accurate estimates of forebody drag of axisymmetric bodies at zero lift from a single shadowgraph picture. Author (ESRO)

N68-15743*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COLD-AIR INVESTIGATION OF A TURBINE FOR HIGH-TEMPERATURE-ENGINE APPLICATION. 3: OVERALL STAGE PERFORMANCE
Warren J. Whitney, Edward M. Szanca, Bernard Bider, and Daniel E. Monroe Washington Feb. 1968 23 p refs
(NASA-TN-D-4389) CFSTI: HC$3.00/MF$0.65 CSCL 10A

An experimental investigation was made to determine the performance of a 30-inch (0.762-m) single-stage turbine, designed for high-engine temperature application. The characterizing features for this application, pertinent to the turbine aerodynamic performance, are thick blade profiles, blunt leading and trailing edges, and low solidity. The turbine developed equivalent design specific work output at equivalent design speed with an efficiency of 0.923, which was the highest efficiency obtained over the range of conditions investigated. The equivalent mass flow, 40.64 pounds per second (18.434 kg/sec), is 1.8 percent greater than the design mass flow. It was concluded that the compromising of the airfoil shapes, which was necessary because of cooling considerations, did not impair the turbine performance. The design mean radius velocity diagram is compared with that calculated from the experimental results obtained at equivalent design speed and equivalent design specific work output. The comparison indicates that an overexpansion occurred across the stator and that the reaction across the rotor was reduced. This effect was attributed to an excessive passage area allowance at the rotor outlet which resulted from an assumed design efficiency which was lower than the experimentally obtained efficiency. Author

N68-15778*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
COMPARISON OF EXPERIMENTAL AND THEORETICAL SHOCK SHAPES AND PRESSURE DISTRIBUTIONS ON FLAT-FACED CYLINDERS AT MACH 10.5
Mamoru Inouye, Joseph G. Marvin, and A. Richard Sinclair Washington NASA Feb. 1968 21 p refs
(NASA-TN-D-4397) CFSTI: HC$3.00/MF$0.65 CSCL 01A

Shock-wave shapes and surface pressures were measured on flat-faced cylinders with shoulder to base radius ratios of 0.0, 0.05, 0.15, 0.25, and 0.5. The measured values were compared with one- and two-strip numerical solutions obtained by the method of integral relations. The two-strip solutions predicted adequately both the shock shapes and surface pressures. The one-strip solutions predicted adequately the shock shapes but underestimated the surface pressures. The shock-wave standoff distances decreased linearly with increasing shoulder radius. The computed stagnation-point velocity gradients increased with increasing shoulder radius, but not linearly. Author

N68-15908 Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium). Turbomachinery Lab.
THE USE OF AN AUXILIARY CASCADE TO IMPROVE THE FLOW IN HIGHLY CAMBERED DECELERATING BLADES
O. Scrofani Oct. 1966 24 p refs
(VKI-IN-18)

An experimental method using an auxiliary cascade of reduced camber and dimensions in comparison with a primary cascade was examined. The auxiliary cascade is intended to prevent boundary layer separation. A two dimensional experiment was conducted in a low speed cascade tunnel using auxiliary cascades of three different geometric configurations. Geometric conditions for the primary cascade were: $\gamma = 35°$; $g/c = 0.800$; $\beta_1 = 60°60$. Configuration A corresponds to an intermediate position of the secondary cascade; configuration B was selected to limit the boundary layer separation towards the trailing edges; configuration C, in a tandem position, was chosen for comparison with the other configurations. The B configuration yielded the best results. The negative pressure gradient was decreased on the suction side, the separation was limited, and the characteristics of the cascade were improved significantly. E.C.

N68-15900# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
RESEARCH ON THE TRANSONIC PROFILES OF LOW DRAG [RECHERCHES SUR DES PROFILS TRANSSONIQUES DE FAIBLE TRAINEE]
M. Vincent de Paul 1967 34 p refs In FRENCH
CFSTI: HC$3.00/MF$0.65

Principal findings of studies in Great Britain, particularly by the National Physical Laboratory, on the improvement of wing profiles in transonic flow are reviewed in light of recent experiences of the French national office for aerospace research. A practical method for determining the Mach number at which drag commences as a result of shock is given that is based on a "shock at the crest" criterion; and the validity of this criterion is discussed. Development of the supersonic zone was analyzed by the method characteristics, and several examples are included to illustrate the method used. Transl. by M.W.R.

N68-15949# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF MOMENTS IN THE PROBLEM OF HYPERSONIC RAREFIED GAS FLOW PAST BODIES [METOD MOMENTOV PRI GIPERZVUKOVOM OBTEKANII TEL RAZREZHENNYM GAZOM]
Yu. Shlazha 18 Jul. 1967 34 p refs Transl into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), no. 3, 1966 p 101–112
(FTD-HT-23-923-67; AD-662824)

The problem of a hypersonic rarefied gas flow past bodies of arbitrary shapes is considered. The method of moments which is used consists in the expansion of the distribution function in orthogonal polynomials in an arbitrary region of the velocity range. Then, on the basis of the Boltzmann or Vallander kinetic equations, a system of integral equations of moments is derived from which the values of macroscopic parameters are determined, the latter being expressed by the expansion coefficients of the distribution function. In the case of hypersonic flows, the polynomials may be constructed asymptotically. As an example, a hypersonic longitudinal flow over a semi-infinite plate is considered and the macroparameters of the flow, that is, density, macroscopic velocity, temperature, stress tensor, and thermal flux vector, are expressed by the expansion coefficients. In conclusion, the author stresses the need for associating the method of integral equations of moments, iteration, and asymptotic methods for the solution of problems of hypersonic aerodynamics of rarefied gases. TAB

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N68-15019# Institut Franco-Allemand de Recherches, St. Louis (France).
BOOMS PRODUCED BY A MIRAGE 3 B IN ACCELERATED FLIGHT—OPERATION JERICHO-FOCALIZATION IN ISTRES FROM 8–16 DECEMBER 1966 [FLUGZEUGKNALLE EINER BESCHLEUNIGT FLIEGENDEN MIRAGE III B, OPERATION JERICHO-FOCALISATION IN ISTRES VOM 8.–10. DEZEMBER 1966]
M. Froboese 10 Aug. 1967 61 p refs In GERMAN
(ISL-T-30/67)

The purpose of the experiments was to register the pressure waves over a fixed distance on the ground and to determine the peak pressure of the boom. Straight, horizontal flights at a constant rate of acceleration and at identical heights were repeatedly made over the measuring range. The measured peak pressures were evaluated for the focussing factor, i.e., for the boom's peak pressure in relation to the pressure of an aircraft in supersonic flight at constant velocity. The paper describes the layout of the range, measuring equipment, and evaluation methods. Graphs containing the resulting data are presented. Transl. by K.W.

N68-15099 Sud-Aviation, Paris (France).
CONCEPTION OF THE AIRFRAME AND AERODYNAMIC PROBLEMS OF THE AEROBUS [CONCEPTION DE LA CELLULE ET PROBLEMS AERODYNAMIQUES DE L'AIRBUS]
C. Roche [1967] 23 p In FRENCH Presented at A.F.I.T.A.E. 4th Colloq. on Appl. Aerodyn., 8–10 Nov. 1967

The overall problems involved in developing the European Aerobus are discussed in terms of the general specifications, the economics of passenger traffic and development costs, and the requirements of airport facilities expansion and modification. The transport is envisioned as having a capacity of 250 to 300 passengers plus 2.5 tons of freight, and a flight range of 350 to 1200 nautical miles at speeds of 0.8 to 0.85 Mach. The configuration assessment factors are listed as safety, maximum use of existing technology, development potential, freight capability, weight, operational factors and airport integration, and operating costs. Transl. by M.G.J.

N68-15100 Nord-Aviation, Paris (France).
INFLUENCE OF THE ATTENUATION RATE ON THE PERFORMANCES OF A JET ENGINE AND OF AN AEROBUS TYPE AIRPLANE [INFLUENCE DU TAUX DE DILUTION SUR LES PERFORMANCES D'UN REACTEUR ET D'UN AVION DU TYPE AEROBUS]
Pierre Guyot and Rene Zolver [1967] 45 p In FRENCH Presented at A.F.I.T.A.E. 4th Colloq. on Appl. Aerodyn.

An assessment is made of the effects of thermodynamic properties on the performance and configurations of turbojet engines, and on the characteristics of the aircraft and the propulsion systems. Calculations are presented to show the mass of propulsion needed to transport 225 passengers and 2600 kg of freight on a trip of 1500 km. The influence of the attenuation rate and the effects of cruising altitude on the wing surface were determined. Results of an optimization study on the European Aerobus are presented. Transl. by M.G.J.

N68-15129# Air Force Systems Command, Wright-Patterson AFB, Ohio. Systems Engineering Group.
GROUND ACOUSTICAL SURVEY OF THE R-57F AIRPLANE WITH TF-33-P-11A ENGINE
John F. Drether and John H. Wafford Oct. 1967 30 p
(SEG-TR-67-28; AD-662597)

Acoustical data measured on the RB-57F airplane empennage exposed to the exhaust of the TF-33-P-11A engine are presented in tabular and graphical form. Data are reduced in octave and 10-CPS band widths along with overall levels. Contours of equal acoustical intensity are transposed on a plan view of the horizontal stabilizer. Author (TAB)

N68-15191 France. Service Technique de l'Aeronautique, Paris.
THE SPIRIT OF THE RULES OF FLIGHT QUALITY [ESPIRIT DU NOUVEAU REGLEMENT DE QUALITE DE VOL]
J. C. Wanner [1967] 34 p In FRENCH Presented at A.F.I.T.A.E. 4th Colloq. on Appl. Aerodyn., 8–10 Nov. 1967

The necessity of adopting new rules and regulations for transport aircraft is discussed, with particular reference to the coming generation of supersonic transports. Certification criteria are assessed in relation to operational problems, the trajectories imposed on the aircraft by the mission requirements, flight tests to verify the capabilities of the plane, and an evaluation of the difficulties the pilot may encounter during flight. Causes and probabilities of malfunctions are examined and identified. Transl. by M.G.J.

N68-15425*# Astro Research Corp., Santa Barbara, Calif.
DEVELOPMENT OF A HIGH ALTITUDE STOKES FLOW DECELERATOR Final Report
Peter G. Niederer 4 Nov. 1966 37 p refs
(Contract NAS5-10168)
(NASA-CR-91905; ARC-R-236) CFSTI: HC $3.00/MF $0.65
CSCL 01C

A decelerator was developed that operates at subsonic descent velocities up to altitudes of 80 to 90 km. It consists of a flat canopy with an open mesh structure of widely spaced fibers. A theory is presented to describe the mechanism of drag generation of such a structure in a highly viscous flow field with a low Reynolds number. Even highly tenuous fiber meshes can have drag coefficients, based on the entire canopy area, that approach unity. Drop tests were conducted to validate the theory. A preliminary design is given for a parachute, referred to as the X-Brace Parachute. Because of its lightweight canopy unusually low descent velocities can be achieved and a high dynamic stability is expected. The maximum altitude for subsonic descent velocities for winddrifters without payload is a function of the material thickness used for the canopy. Practical winddrifter designs come close to this maximum altitude limit. Author

N68-15562# Dynasciences Corp., Blue Bell, Pa.
STABILITY AND CONTROL HANDBOOK FOR HELICOPTERS Technical Report, Jun. 1964–Jun. 1967
E. Kisielowski, A. A. Perlmutter, and J. Tang Aug. 1967 523 p ref
(Contract DA-44-177-AMC-197(T))
(DCR-186; USAAVLABS-TR-67-63; AD-662259)

Analytical methods are presented for determining the dynamic stability and control characteristics of generalized procedures which are considerably simplified through the extensive use of information presented in graphs and charts. These charts are applicable to flight conditions from hover to high forward speeds. The charts for low forward speeds were obtained from the rotor performance data based on classical rotor theory. However, the high-speed charts exclude the major assumptions of classical theory and include blade compressibility, stall, reverse flow, large inflow ratios, etc. The handbook contains information suitable for extensive digital and analog computer studies and also provides rapid procedures for predicting helicopter stability and control characteristics for preliminary design applications. Author (TAB)

N68-15756# Aeronautical Research Council (Gt. Brit.).
SOME FLIGHT MEASUREMENTS OF CROSSWIND LANDINGS ON SMALL DELTA AIRCRAFT (AVRO 707A)

K. J. Staples London HMSO 1967 29 p refs Supersedes RAE-TR-65076; ARC-27149 See X66-10011
(ARC-R&M-3476; RAE-TR-65076; ARC-27149) CFSTI: HC $3.00/MF $0.65

Pilot's control movements and the accuracy of touchdown have been analyzed for two distinct crosswind landing techniques. The side-slipping technique gave generally better accuracy at touchdown. On the other hand, the crabbing technique required slightly less aileron control power and was more comfortable for the pilot, but it made considerable demands on pilot judgement in the drift removal manoeuvre. Author (ESRO)

N68-15811# National Research Council of Canada, Ottawa (Ontario).
QUARTERLY BULLETIN OF THE DIVISION OF MECHANICAL ENGINEERING AND THE NATIONAL AERONAUTICAL ESTABLISHMENT, 1 JULY–30 SEPTEMBER 1967
30 Sep. 1967 121 p refs
(DME/NAE-1967-(3))

Papers on current activities and project notes are presented. The resistance of aircraft windshields to bird impact was studied, and the effects of windshield temperature were included. The heat transfer in a two-phase thermosyphon tube was investigated, and it is felt that the sealed tube form has heat transfer performance which is adequate for many applications. Errors in measuring mean static pressures of a moving fluid due to pressure measuring holes are examined, and experimental results for large holes at high Reynolds numbers for zero pressure gradient subsonic and supersonic conditions outside turbulent boundary layers are presented. N.E.N.

N68-15894*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STATIC AND DYNAMIC LONGITUDINAL STABILITY DERIVATIVES OF A POWERED 0.18-SCALE MODEL OF A FAN-IN-WING VTOL AIRCRAFT
Joseph R. Chambers and Sue B. Grafton Washington Feb. 1968 66 p refs
(NASA-TN-D-4322) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An investigation was conducted to determine the static and dynamic longitudinal stability derivatives of a powered fan-in-wing V/STOL aircraft model for trimmed level flight at an angle of attack of 0°. The model had a lift fan located in each wing panel and a smaller fan located in the nose for pitch control. The investigation covered a range of values of thrust condition and oscillatory frequencies for the model with the horizontal tail both on and off. The results of the investigation indicate that the model was statically unstable with respect to angle of attack and was statically stable with respect to velocity for the lower speeds for fan-powered flight; these trends tended to reverse as the transition to conventional wingborne flight progressed. The model had positive damping in pitch (negative values of the damping-in-pitch parameter) throughout the ranges of test conditions investigated. Author

N68-15941*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
CALCULATION OF THE DYNAMIC LONGITUDINAL STABILITY OF A TILT-WING V/STOL AIRCRAFT AND CORRELATION WITH MODEL FLIGHT TESTS
Joseph R. Chambers and Sue B. Grafton Washington Feb. 1968 63 p refs
(NASA-TN-D-4344) CFSTI: HC $3.00/MF $0.65 CSCL 01C

An analytical study has been conducted to determine the important factors influencing the dynamic longitudinal stability characteristics of a typical tilt-wing V/STOL aircraft. Calculations have been made for the initial condition of steady level flight at wing incidences corresponding to speeds ranging from hovering to conventional forward flight. The results of the calculations have been compared with qualitative measurements of dynamic stability obtained during free-flight tests of a 1/8-scale model of the aircraft. The results of the investigation indicated that the control-fixed motions of the aircraft without artificial stabilization in hovering flight would be dominated by an unstable oscillation similar to that displayed by most helicopters. As the transition to conventional forward flight progressed, stability characteristics were encountered in which aperiodic divergent modes of motion, as well as unstable oscillations, were present. These results also indicated that the unstable oscillation occurring in the hovering and low-speed flight regions can be stabilized by the addition of a combination of pitch-rate and pitch-attitude stabilization, but that angle-of-attack stability must be increased if the aperiodic divergent modes of motion are to be made stable. Author

N68-16050*# National Aeronautics and Space Administration, Washington, D. C.
NASA FLIGHT RESEARCH CENTER
1967 4 p
(NASA Facts-0-4/8-67) CSCL 01B

The flight testing activities at the research center in Edwards, California, are briefly described. The aircraft tested are enumerated, beginning with the X-1, the first to exceed the speed of sound. Emphasis is given to the X-15, the XB-70, and a General Purpose Airborne Simulator equipped with special control systems and computers. The testing of lifting bodies and a Lunar Landing Research Vehicle are also mentioned. It is pointed out that the large heat laboratory is suitable for testing supersonic transports. N.E.N.

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N68-15183# European Space Technology Center, Delft (Netherlands).
ESRO 2 POWER SYSTEM: BATTERY CONTROL SYSTEM
A. W. Preukschat Paris, ESRO, Dec. 1966 11 p
(ESRO-TM-22) CFSTI: HC $3.00/MF $0.65

The ESRO II battery charge and discharge control system is described. After reviewing the charge and discharge parameters to be controlled during battery operation, the author discusses the control system elements. From this discussion it is concluded that the battery is adequately controlled and protected under all operational conditions that the spacecraft is likely to encounter. Author (ESRO)

N68-15230# Minnesota Mining and Mfg. Co., St. Paul, Minn.
560-WATT PORTABLE THERMOELECTRIC POWER MODULE Final Report
Thomas L. Nystrom, John H. Stauffer, and Edwin W. Pitcher Sep. 1967 57 p refs
(Contract DA-44-009-AMC-1607(T))
(AD-662770)

The objective of the research and development program is the design, fabrication, testing and delivery of a thermoelectric

power module with the following principal requirements: Power - 560 watts at 28 volts dc; Weight - 35 pounds or less; Fuel - JP-4, CITE, or diesel fuels logistically available to the U.S. Army; Life - Continuous or intermittent operation of at least 1000 hours; Noise Level - Inaudible at a distance of 100 feet. A power module was delivered which demonstrates compliance with these requirements. Author (TAB)

N68-15248# VARTA Aktiengesellschaft Forschung- und Entwicklungszentrum, Kelkheim (West Germany).
CONSTRUCTION OF A HYDROGEN–OXYGEN FUEL CELL AND ITS PERFORMANCE WITHIN THE TEMPERATURE RANGE −20°C TO +60°C [AUFBAU EINER WASSERSTOFF-SAUERSTOFF-BRENNSTOFFZELLBATTERIE UND IHR VERHALTER IM TEMPERATURBEREICH VON −20°C BIS +60°C]
K. Weidinger Bad Godesberg (West Germany) Bundesmin. fuer Wiss. Forsch. May 1967 21 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-04)

In order to study the temperature influence on the mechanical and electrochemical properties of a fuel-cell-battery an investigation was carried out within the temperature range −20°C to +60°C. No mechanical defects due to differences in thermal expansion of metal-electrodes and plastics (used for framing) could be observed. There is a strong temperature influence, however, on the electrochemical performance. Nevertheless an operation of the fuel-cell below 0°C is possible, as long as the power densities are low. Author

N68-15249# VARTA Aktiengesellschaft Forschung- und Entwicklungszentrum, Kelkheim (West Germany).
FUEL CELL PUMPS FOR GAS AND ELECTROLYTE CIRCULATION [PUMPEN FUER GAS- UND LAUGEHAUSHALT BEI BRENNSTOFFZELLEN-BATTERIEN]
D. Hahn and H. -J. Schwartz Bad Godesberg (West Germany) Bundesmin. fuer Wiss. Forsch. May 1967 43 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-03)

The specifications of gas- and electrolyte pumps in connection with fuel cell operation conditions are described. Calculation and design of an electrolyte pump input about 2 W are described having a feed rate of about 3 1/min at a pressure of 1 m WC. Furthermore a H_2-gas pump, its design (solenoid type) and operation conditions as well as its characteristical data are presented. It had a feed rate of 100 to 200 1/h at a pressure of 1 m WC. The results, obtained during these investigations are discussed and suggestions are made for further development. Author

N68-15275# Army Electronics Labs., Fort Monmouth, N. J.
EVALUATION OF FOREIGN S-12 SILVER ZINC CELLS
Otto C. Wagner Oct. 1967 28 p
(ECOM-2884; AD-662737)

Two foreign S-12 silver-zinc cells used to power a transceiver were evaluated. Low temperature performance was significantly poorer than that of comparable US cells, while room temperature performance was equivalent. Dissection of one S-12 cell showed that it was designed with an excess of silver powder and that it contained a separator wrap which will limit the useful life of the cell to three to four months, particularly for applications in the tropics. Another shortcoming of the S-12 cells is that the zinc negatives are wrapped in cellophane membrane, a design feature which will decrease the zinc capacity at high rates and/or low temperatures. To maintain maximum capacity under extreme environmental conditions it is standard practice in the US to wrap the silver positives in cellophane membrane. Author (TAB)

N68-15338# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
HEAT PIPE APPLICATION FOR SPACECRAFT THERMAL CONTROL
D. K. Anand and R. B. Hester Aug. 1967 94 p refs
(Contract NOw-62-0604-c)
(TG-922; AD-662241)

A heat pipe is a device which exhibits an extremely high effective thermal conductivity by means of two-phase fluid flow with capillary circulation. The primary objective of the experimental program was to determine a suitable method of control for the heat pipe and to establish suitable wick/fluid configurations for the various temperature ranges of interest. The primary objective of the prototype program was to provide design, construction, testing for verification, and flight hardware specifications of a heat pipe applicable to thermal control of a spacecraft or a spacecraft subsystem. Thus, a thermal design improvement for spacecraft could be proposed; in addition, thermal resistances of heat pipes could be derived. Author (TAB)

N68-15505*# Metals and Controls, Inc., Attleboro, Mass. Research and Development Labs.
HEAT STERILIZABLE Ni–Cd BATTERY DEVELOPMENT Quarterly Report, 1 Jul.–30 Sep. 1967
P. V. Popat and E. J. Rubin 30 Sep. 1967 38 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951972)
(NASA-CR-92531; QR-1) CFSTI: HC $3.00/MF $0.65 CSCL 10C

A panel consisting of 60 test stations which monitor current, voltage and resistance of the cells was constructed. This panel was subsequently integrated into our existing data acquisition system which automatically records the pertinent electrochemical parameters. Several polypropylene separators were selected for further evaluation on the basis of their thermal and chemical stability in 7N KOH. Approximately forty cylindrical cells were constructed using these separators. Pellon 14019 separator is the most promising in terms of lower voltage, lower resistance, higher capacity and lower uniformity both before and after sterilization. All cells evaluated exhibit an increase in end-of-charge voltage after sterilization. This effect cannot be explained by resistance increases and is believed associated with morphological changes at the cadmium electrode. At present glass-to-metal seals which are protected by a KOH resistant coating have been the most successful in undergoing heat sterilization. Author

N68-15525# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.
FUEL CELL–BATTERY POWER SOURCES FOR ELECTRIC CARS
Galen R. Frysinger 1967 8 p Presented at Power Systems for Elec. Vehicles Symp., Columbia Univ., 6–8 Apr. 1967
(AD-662235)

Through the use of a fuel cell-battery hybrid power source all of the so-called vehicle battery problems can be overcome. This power source allows an electric vehicle to have: (1) Full range capability. (2) Excellent acceleration characteristics. (3) Very fast energy refuel. To achieve the performance outlined for the vehicle, requires the successful development of a 150 watt hour per pound molten electrolyte battery and a 20-35 lbs/KW hydrocarbon fuel cell. Research progress indicates that these goals should be achieved in operational hardware within the next five to ten years. Author (TAB)

N68-15552*# North American Aviation, Inc., Downey, Calif. Space and Information Systems Div.
A STUDY OF ELECTRONIC PACKAGES ENVIRONMENTAL CONTROL SYSTEMS AND VEHICLE THERMAL SYSTEMS INTEGRATION Quarterly Report, Nov. 1966–Jan. 1967

L. Isenberg and D. J. Watanabe 31 Jan. 1967 72 p ref
(Contract NAS8-20320)
(NASA-CR-61485; SID-67-209; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 13A

Efforts were devoted to establishing the heat balances of the combined astrionic equipment and the thermal conditioning subsystem of the environmental control system for various heat loads, environmental conditions, values for surface finishes, and other significant parameters. The heat balance of an electronic package mounted on the instrument unit structure was also investigated to determine the feasibility of a purely passive thermal control approach. Results indicate that for the orbital conditions considered the passive approach appears feasible for those electronic packages with a wide temperature tolerance. Mission and vehicle models were finalized along with the mission profile. These consist of various combinations of near earth and synchronous earth orbits launch and vehicle configurations. The vehicle configurations are basically the instrument unit attached to the S-IVB with various configurations mounted on the forward end of the instrument unit. Author

N68-15641# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.
FUEL CELL-ENERGY STORAGE HYBRID SYSTEMS FOR VEHICLES
Galen R. Frysinger 1967 27 p
(AD-662236)

Through the use of a fuel cell-battery hybrid power source all of the so called vehicle battery problems can be overcome. This power source allows an electric vehicle to have: (1) Full range capability, (2) Excellent acceleration characteristics, (3) Very fast energy refuel. To achieve the performance outlined for the military vehicle requires the successful development of a 150 watt hour per pound molten electrolyte battery and a 20-35 lbs/KW hydrocarbon fuel cell. Research progress indicates that these goals should be achieved in operational hardware within the next five to ten years. Author (TAB)

N68-15712# Army Electronics Labs., Fort Monmouth, N. J. Electronic Components Lab.
BATTERY-FUEL CELL SYSTEM
Galen R. Frysinger 1967 22 p Presented at 21st Ann. Power Sources Conf., Atlantic City, May 1967
(AD-662234)

Through the use of a fuel cell-battery hybrid power source for vehicular propulsion all of the battery problems can be overcome. This power source allows an electric vehicle to have: (1) full range capability, (2) excellent acceleration characteristics, and (3) use of conventional hydrocarbon fuels. To achieve the required performance depends upon the successful development of a 150 watt hour per pound molten electrolyte battery and a 20-35 pound per kilowatt hydrocarbon-air fuel cell. Research progress indicates that these goals should be achieved in operational hardware within the next five to ten years. Author (TAB)

N68-15718*# Yardney Electric Corp., New York.
STUDY TO INVESTIGATE AND IMPROVE THE ZINC ELECTRODE FOR SPACECRAFT ELECTROCHEMICAL CELLS Final Report, 30 May 1966–30 Jun. 1967
James McBreen Oct. 1967 48 p refs
(Contract NAS5-10231)
(NASA-CR-92599) CFSTI: HC $3.00/MF $0.65 CSCL 10C

The diffusivity of zincate in free alkaline electrolyte was investigated as a function of KOH concentration and temperature. A qualitative explanation is given for deviations from the Einstein–Stokes equations. Plastic separator membranes in zincate electrolyte show varying degrees of selectivity for zincate ions. The distribution coefficient for zincate in the membranes in equilibrium with zincate electrolyte is less than one and varies by a factor of seven for the membranes tested. The zincate diffusivity in plastic membranes is directly proportional to the conductivity of the membranes in the alkaline electrolyte. Both parameters are related to the pore sizes of the membranes. Silver zinc cells were cycled using a zinc overvoltage cutoff (75 mV). No penetration of the membranes occurred under these conditions. High resistivity membranes accelerate shape change. The best shape retention was found with low resistivity cellulosic membranes. Author

N68-15786* Thermo Electron Engineering Corp., Waltham, Mass.
SIX-CONVERTER SOLAR THERMIONIC GENERATOR (JG-4) Quarterly Progress Report, 1 Jul.–15 Dec. 1967
P. K. Shefsiek, T. Athanis, and L. Lazaridis 15 Dec. 1967 57 p ref Prepared for JPL
(Contracts NAS7-100; JPL-951770)
(NASA-CR-92586; TE-4073-70-68; QPR-2) CFSTI: $3.00 CSCL 10A

This work involves the design and fabrication of a Six-Converter Solar Thermionic Generator designated JG-4. During this reporting period the complete design was finalized, six converters were fabricated and tested, and all generator components were fabricated. Also, the components for six other converters have been fabricated and processed. Author

N68-15787*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FEASIBILITY STUDY 30 WATT PER POUND ROLL UP SOLAR ARRAY Quarterly Technical Report, 30 Sep.–31 Dec. 1967
N. F. Shepard, F. A. Blake, W. S. Busch, A. Latour, P. J. De Martino et al 24 Jan. 1968 114 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951970)
(NASA-CR-92530; Doc.-68SD4208; QTR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Results of activities performed to establish the feasibility of a 30 watt per pound roll-up solar array are reported. These include the preliminary detailed design of each major subsystem component, tradeoff studies which led to the selected configuration, and experimental test data on various deployable boom components. A weight summary based on this design is included. This preliminary design has established the feasibility of meeting the 30 watt/lb goal. Author

N68-15800*# Electro-Optical Systems, Inc., Pasadena, Calif.
PLANETARY SOLAR ARRAY DEVELOPMENT
R. Wiznick 6 Jan. 1968 73 p Prepared for JPL
(Contracts NAS7-100; JPL-952035)
(NASA-CR-92532; EOS-7254-Q-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

The purpose of this study program is to provide a conceptual design of a photovoltaic solar array capable of producing 200 watts of raw electrical power on the Martian surface at solar noon. This report summarizes findings regarding the most promising array concepts and discusses work to generate detail designs of each of the promising concepts. The array summary covers selection of array concepts and general design studies, including a deployable fixed array, two-axis arrays mounted either horizontally or vertically, solar circuit design, substrate design, and materials. Tabulated estimates of panel temperatures are presented for solar noon at the design power level and the equator at perihelion. K.W.

N68-15838# Battelle Memorial Inst., Columbus, Ohio.
DETERIORATION OF FUELS AND FUEL-USING EQUIPMENT Final Report
David A. Trayser, Glen M. Hein, and Warren C. Ellis Aug. 1967 86 p refs Prepared for Dept. of the Army
(AD-662266)

The study covered two closely related areas of investigation: (1) the deterioration of fuels and equipment in storage and (2) the standby maintenance requirements of auxiliary power systems for community protective shelters. Determination of the state-of-knowledge and current practices in the first area of investigation led to the devising of specific plans of action in the second area. A number of plans for standby-maintenance routines for community shelter power systems were devised during the study. These plans are based on the best information available from the literature and from field experience. The costs for acquisition, installation, and maintenance of these systems and for the standby maintenance routines are estimated and compared on the basis of 5-, 10-, and 15-year standby periods. From the results it appears that a gasoline engine power system utilizing commercial fuels and preservatives, maintained in a low-humidity environment, and exercised every 6 weeks, would provide maximum cost effectiveness considering the present state of knowledge. It was noted during this study that information is particularly sparse in the areas of: long-term storage effects on commercial and special fuels and lubricants, inactive storage of engine-generator sets in a reasonable state of readiness, and the fuel-deterioration tolerance of gasoline and diesel engines. Recommended specific research programs to close each of these technological gaps are briefly described.
Author (TAB)

N68-15856*# Idaho State Univ., Pocatello. Dept. of Chemistry.
THE REACTIONS PERTAINING TO ZINC-SILVER AND CADMIUM-SILVER BATTERIES Quarterly Report
G. Myron Arcand 15 Dec. 1967 13 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951887)
(NASA-CR-92546; QR-3) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Preliminary experiments indicate that electrochemical oxidation of zinc in 10 *VF* KOH produces less than 10% $Zn(OH)_2$ and more than 90% ZnO. The product is blue-gray while in the KOH, but changes to white upon being washed with water. The rate of conversion of AgO to Ag_2O rapidly increases with increasing temperature. Fifty percent conversion occurs in 24 hours at 121°, 11 hours at 131°, 4 hours at 141°, 2 hours at 151°, and 1 hour at 160°. The rate of conversion depends on the method of preparation of the original material. The solubility concentration of Ag(1) in 10 *VF* KOH saturated with ZnO is about 4×10^{-4} *VF*. This concentration is reached in less than a half-hour in a stirred system containing solid AgO and somewhere between 25 and 100 hours in an unstirred system containing a AgO electrode. The concentration of Ag(1) drops to less than 1×10^{-4} *VF* in 24 hours when a zinc plate is placed in the solution, provided no solid AgO is present.
Author

N68-15864*# Ryan Aeronautical Co., San Diego, Calif.
FEASIBILITY STUDY 30 WATTS PER POUND ROLLUP SOLAR ARRAY Quarterly Report, 1 Nov.–31 Dec. 1967
15 Jan. 1968 128 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951971)
(NASA-CR-92579; Rept.-40067-2; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Principal efforts were applied to preparation of the detail design of the array structure and mechanisms, and to manufacturing drawings for a demonstration model of the selected design concept. Analytical support focused on substantiation of the detail design. Additional studies were performed of dynamic criteron effects on components of the wrap drum. Thermal studies were extended to evaluate another thin film (perferred) material for the substrate and its influence on solar cell temperatures. Electrical design considerations included feasibility studies and ramifications of using a larger size, solar cell and a coverglass application concept. Preliminary evaluations suggest improvement in the array power to weight characteristics and net savings in the estimated cost of cell installation.
Author

N68-15889*# Monsanto Research Corp., Dayton, Ohio. Dayton Lab.
SILVER–ZINC BATTERY SEPARATOR MATERIAL DEVELOPMENT Quarterly Progress Report, 1 Oct.–31 Dec. 1967
I. O. Salyer, E. V. Kirkland, P. H. Wilken, and R. J. Taylor 10 Jan. 1968 20 p Prepared for JPL
(Contracts NAS7-100; JPL-951966)
(NASA-CR-92551; QPR-2) CFSTI: HC $3.00/MF $0.65 CSCL 10C

Several ethylene/methyl acrylate copolymers have been synthesized in a small batch-operated autoclave at high pressures. By controlling the degree of conversion and incremental monomer addition, the product composition may now be predetermined, despite unfavorable monomer activity ratios. The molecular weight of the polymer product can also be controlled now by incorporating a chain transfer agent so that product with a desirable melt viscosity may be predetermined. The copolymer composition currently is calculated from elemental analysis of carbon and hydrogen content; this appears to be the most precise method at the moment. A thin film of polymer (about 1 mil) has been successfully prepared by casting from a warm dope. In the latter process, the film is vulcanized in a separate step. Samples of film for more than test work may be prepared by blow extrusion. The resistance of a recently prepared membrane (5.3 mil thick, dry) of ethylene/acrylic acid copolymer was measured at 0.055 ohm in^2. The bridge employed has been shown to be satisfactory for resistance measurements by means of a reference membrane sample.
Author

N68-15938 Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaire.
ENERGY STORAGE POSSIBILITIES OF SUPERCONDUCTORS WITH A VIEW TO LARGE POWER DISCHARGES [STOCKAGE D'ENERGIE POSSIBILITIES DES SUPRA-CONDUCTEURS EN VUE DES DECHARGES DE GRANDES PUISSANCES]
Jean Sole Jun. 1967 14 p refs In FRENCH
(CEA-R-3243)

Condensers, turning machines, combustible piles, accumulators, and explosives are considered in relation to energy storage possibilities of superconductors. Energy supply, role of dielectrics, and energy density in dielectric materials are discussed for the semiconductors; and attention is given to the optimization of energy storage and release of energy.
Transl. by M.W.R.

N68-15943*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ANALYTICAL DETERMINATION OF RADIAL INFLOW TURBINE DESIGN GEOMETRY FOR MAXIMUM EFFICIENCY
Harold E. Rohlik Washington Feb. 1968 32 p refs
(NASA-TN-D-4384) CFSTI: HC $3.00/MF $0.65 CSCL 10A

Radial turbine performance was examined analytically in order to determine optimum design geometry for various applications as characterized by specific speed. Five specific losses were calculated for various combinations of stator-exit flow angle, outlet- to inlet-diameter ratio, and the ratio of stator blade height to rotor-exit

diameter. The losses considered were stator loss, rotor loss, tip-clearance loss, windage, and exit kinetic energy. Resulting static efficiencies ranged from 0.23 to 0.87 for a specific-speed range of 15 to 173 (0.12 to 1.34). Turbine pressure ratio had no appreciable effect on optimum geometry except in the case of stator blade height. Curves of blade-jet speed ratio, stator-exit flow angle, tip-diameter ratio, and the ratio of stator blade height to rotor-inlet diameter are presented for maximum static efficiency over a wide range of specific speed. These curves permit the systematic selection of optimum turbine size and shape for a variety of turbine applications. An exit diffuser of 0.6 effectiveness was examined for its effect on overall performance. The gain in static efficiency was appreciable except at very high specific speeds where a lower diffuser effectiveness or a different type of turbine would be required. Author

N68-15990# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF ENERGY TRANSFORMATIONS

Zygfryd Jung *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. In 1965 Aug. 1967 p 76–77 refs (See N68-15982 06-34)

Studies of the optimization of the power system of Poland are briefly mentioned. Energy consumption by the domestic consumer and forecasting the demand for electric power were investigated. The use of television sets is considered to be of increasing importance during the afternoon peak load, and problems connected with the supply of coal to the power station are reported. N.E.N.

N68-15993*# AiResearch Mfg. Co., Phoenix, Ariz.

AIRESEARCH BRAYTON CYCLE DEMONSTRATOR TEST PROGRAM Final Test Report

15 Nov. 1967 146 p

(Contract NAS9-6116)

(NASA-CR-65924; APS-5270-R) CFSTI: HC $3.00/MF $0.65 CSCL 10B

The equipment, procedures, and methods used in the Brayton cycle demonstrator checkout tests are described. The data acquisition and reduction methods are reviewed, and a complete presentation of the test results is included. The following conclusions have been drawn: (1) the feasibility of utilization of a high speed Combined Rotating Unit (CRU), supported on gas bearings was proven, (2) magnetic loads imposed on the CRU gas bearing system are not a limiting factor, (3) gas injection startup techniques and control systems operation for gas bearing supported turbomachinery in closed loop applications were demonstrated, (4) high performance potential of the Brayton cycle system was confirmed, and (5) the range of testing demonstrated the high degree of system flexibility. C.T.C.

N68-16071*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

IMPACT TESTING OF THERMOELECTRIC HARDWARE FOR SPACE POWER APPLICATIONS

L Selwitz 15 Jan. 1968 12 p

(Contract NAS7-100)

(NASA-CR-92703; JPL-TM-33-363) CFSTI: HC $3.00/MF $0.65 CSCL 10A

As part of an overall thermoelectric failure-mode testing and analysis program a series of high-g impact tests is being conducted to determine the effects of potential hard-landing missions on thermoelectric hardware. Two thermoelectric devices have been tested to date: Westinghouse tubular modules and RCA silicon–germanium couples. The Westinghouse module, an early high-efficiency prototype (HEP) series unit, successfully survived a 10,000-g impact shock with no apparent deleterious effects. A group of RCA couples successfully survived impact loads of up to 2000 g with no changes in their physical characteristics. Author

N68-16074* Thermo Electron Engineering Corp., Waltham, Mass.

SOLAR THERMIONIC GENERATOR DEVELOPMENT Quarterly Report, 1 Sep.–30 Nov. 1967

Dec. 1967 45 p Prepared for JPL

(Contracts NAS7-100; JPL-951283)

(NASA-CR-92520; TE-4055-83-68; QR-8) CFSTI: $3.00 CSCL 10A

Progress is reported in the development of a solar thermionic generator. Areas discussed include (1) testing of converter T-207 using the S-type of filament as the electron bombardment source, (2) fabrication of converter T-208, and (3) selection of a multiconverter generator configuration and calculation of its electrical performance for earth test and cislunar operation. Detailed test results are shown in both graphical and tabular form. C.T.C.

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N68-15072# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON THE PROSPECTS OF THE USE OF SOME BIOLOGICAL REACTIONS FOR STUDYING THE FLUCTUATIONS OF COSMIC RADIATION

A. V. Kovaltchuk *In its* Cosmic Rays, No. 8 1967 p 206–208 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 08-29)

To further investigate cosmic radiation influence upon biological objects, the study of some physiological indications of human organisms were carried out daily in various regions in the European part of the U.S.S.R. On the basis of the vast statistically reliable material, it has been established that the erythrocyte content in the periphery blood may be considered as the most sensitive indication of the daily cosmic radiation changes. Usually the erythrocyte number varies synchronously with the solar activity changes (the trend of the changes also depends upon the solar activity level), and the expressiveness of the trend is increased from the south to the north. While comparing the flattened daily mean values of the erythrocyte content with the corresponding flattened values of the solar activity expressed in Volf's numbers the following values of the correlation coefficient were obtained: at medium solar activity the connection is reverse $r \approx -(0.6–0.7)$; at high solar activity ($W > 70–100$) the erythrocyte number is changed in parallel with the solar activity ($r \approx +0.5$). Author

N68-15127# RAND Corp., Santa Monica, Calif.

INPUT–OUTPUT RELATIONS FOR AXO-SOMATIC ACTIVATION IN A NEURON MODEL

R. J. MacGregor Nov. 1967 29 p refs

(P-3672; AD-662334)

Previous experimental findings have suggested that axo-dendritic activation is the primary source of nonlinear integration among input pulses while axo-somatic activation mediates a relatively inflexible driving influence on the cell. Our own previous work has examined a theoretical basis for this distinction and presented a model to account for the nonlinear properties of axo-dendritic activation. The present paper addresses the properties of axo-somatic activation with a digital-computer simulation of the elicitation of spikes by postsynaptic potentials. Input-output relations for regular and irregular temporal patterns of excitatory activation, and for combined excitatory and inhibitory activation are presented. The results corroborate the hypothesis. Author (TAB)

N68-15135# School of Aerospace Medicine, Brooks AFB, Tex.
A METHOD TO MANUFACTURE PELLETIZED FORMULA FOODS IN SMALL QUANTITIES
Norman D. Heidelbaugh and Marvin A. Rosenbusch Aug. 1967 11 p
(SAM-TR-67-75; AD-662328)

A pelletizer was developed for manufacturing pellets from powdered formula food. Details for the construction of the pelletizer are presented. Tests on the use of the pelletizer showed it to be practical for production of small quantities of pellet foods such as might be needed in scientific studies involving feeding of human subjects. Author (TAB)

N68-15139* Public Health Service, Phoenix, Ariz. Planetary Quarantine Unit.
SERVICES PROVIDED IN SUPPORT OF THE PLANETARY QUARANTINE REQUIREMENTS Quarterly Report, Oct.–Dec. 1967
M. S. Favero 19 Jan. 1968 21 p
(NASA Order R-137)
(NASA-CR-91815; QR-20) CFSTI: $3.00 CSCL 06M

Studies in support of NASA planetary quarantine requirements are reported, and numerous tables and graphs summarize the results. Data from the study of the probability of release of spores of Bacillus subtilis var niger from fractured plastic were analyzed, and two vacuum probes developed for microbiological surface sampling were obtained and used. Studies concerning the use of ultrasonics for recovering microorganisms from surfaces were continued, as were studies on the kinetics of dry heat inactivation of naturally occurring spores. Also continued were investigations of the levels of microbial contamination in intramural environments in a clean room, sterilization and assembly laboratory, and Surveyor fuel-loading room; and results from swab samples from Surveyors 6 and 7 are included. A 96% reduction in aerobic mesophilic microorganisms was noted after final cleaning of the Surveyor 6 spacecraft. M.W.R.

N68-15166*# Techtran Corp., Glen Burnie, Md.
AMINO ACIDS OF FULVIC AND HUMIC ACIDS IN CERTAIN TYPES OF SOILS [AMINOKISLOTNYY SOSTAV GUMINOVYKH KISLOT I FUL'VOKISLOT NEKOTORYKH TIPOV POCHV]
N. G. Zyrin, M. F. Ovchinnikova, and D. S. Orlov Washington NASA Jan. 1968 15 p refs Transl. into ENGLISH from Agrokhimiya (Moscow), no. 4, 1964 p 108–120
(Contract NASw-1695)
(NASA-TT-F-11484) CFSTI: HC $3.00/MF $0.65 CSCL 06A

One-way paper chromatography is used to study the relationships between various amino acids and groups of acids in various soils under various plant covers. Seventeen amino acids were determined. The content of amino acids correlated well with condensation of the humic materials. The relative contents of amino acids were found to be quite consistent, varying mostly with plant types; the relative contents of types of amino acids was determined by microbiological activity in the soil, not soil type. The nitrogen in the amino acids was 30–50% of the total hydrolyzable forms present in the soil. Author

N68-15180# Army Aeromedical Research Univ, Fort Rucker, Ala.
EFFECTS OF DOWNWASH UPON MAN
William P. Schane Nov. 1967 44 p refs
(USAARU-68-3; AD-662208)

The threats imposed upon man by helicopter and VTOL downwash are explored. Information is derived from (1) reference material, (2) mathematical calculation, (3) individual data collection, and (4) personal experience. Eight types of threat are explored in some detail, and conclusions are drawn concerning needs for protection. Author (TAB)

N68-15205# Oxford Univ. (England). Nuffield Dept. of Orthopaedic Surgery.
STUDY OF THE EFFECTS OF OXYGEN TENSION ON OSTEOGENESIS Final Technical Report, Apr. 1966–Mar. 1967
H. C. Ezra Aug. 1967 65 p refs
(Contract DA-91-591-EUC-4048)
(E-1085; AD-660445)

The purpose of this research project is to investigate the role of oxygen in osteogenesis. It was necessary to develop a method which would allow for the direct quantitative measurement of oxygen in the extracellular fluid of living bone cells. The system developed for this purpose is the oxygen microelectrode ear chamber. The results indicate that there is an overall reduction of oxygen tension in the part of the chamber occupied by the living bone culture. There is also a reduction in oxygen tension of the chamber as a whole compared with that prior to the introduction of the graft. It is concluded from the results that the ear chamber is a reliable, reproducible system with respect to quantitating directly gas tensions of in vivo cultures and their surrounding media. It is uniquely suitable for studying at the cellular level the diffusion of gases in viable calcified tissues. Author (TAB)

N68-15290# Buenos Aires Univ. (Argentina).
RADIATION DAMAGE IN MUSCLE MEMBRANES AND REGULATION OF CELL METABOLISM Final Report, Feb. 1962–Mar. 1963; Feb. 1964–Apr. 1967
Adolfo Portela Sep. 1967 14 p refs
(Grant DA-ARO-49-092-66-G131)
(Rept.-3; AD-662723)

The study is concerned with the effect of x-radiation upon those properties and function of muscle cells. The research program was additionally extended to the study of cell membrane behaviour under the presence of cesium and quaternary ammonium ions, as well as to chemical damage studies with enzyme upon the molecular membrane structure. Unfortunately it was not possible to accomplish the proposed idea of studying the effects of x-radiation on the membrane mechanisms related to the Ach. Ch interaction, as well as the comparison of the radiation changes and the enzymatic alteration on the muscle membrane. The comparison between, mechanical, electrochemical, biochemical and structural changes in frog muscles following x-irradiation have contributed fundamentally to a basic understanding of the effects of irradiation on membrane system and control mechanism. Basically, the contribution was again oriented to obtain a better understanding of the effects of ionizing radiation in the sequence of processes taking place in the membrane and responsible for regulating the membrane potential as well as the membrane organization and function. Changes in the membrane permeability, and processes of membrane potential

regulation, as well as in the processes related to uncoupling of oxidation and phosphorilation, due to radiation were considered an important observation of cell damage. Author (TAB)

N68-15339# Joint Publications Research Service, Washington, D. C.
PECULIARITIES OF PHYSIOLOGICAL REACTIONS OF PILOTS DURING SIMULATED EGRESS FROM A SPACECRAFT
D. G. Maksimov 31 Jan. 1968 20 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Biol. (Moscow), no. 5, Sep.–Oct. 1967 p 682–693
(JPRS-44209) CFSTI: HC $3.00/MF $0.65

The physiological reactions of pilots who have undergone training for space flight, in emerging from a Voskhod spacecraft placed in a rarefied atmosphere in a thermobarochamber, were recorded. Results indicate that egress is accompanied by clearly marked changes in pulse and respiration rate, body temperature, weight, and (in some cases) changes in the shape of the electrocardiogram complexes of the command pilots, which show appreciable nervous-emotional strain. The degree of physiological function change drops off sharply in repeat testing. L.S.

N68-15422*# California Univ., Berkeley. Space Sciences Lab.
ENZYME ACTIVITY IN TERRESTRIAL SOIL IN RELATION TO EXPLORATION OF THE MARTIAN SURFACE
Semiannual Progress Report, 1 Jul.–31 Dec. 1967
J. J. Skujins and A. D. McLaren 15 Jan. 1968 150 p refs *Its* Ser. No. 9, Issue 4
(Grant NsG-704-05)
(NASA-CR-92528; SAPR-7) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The behavior of enzymes in nonclassical systems are discussed with emphasis on the action of soluble enzymes on insoluble substrates, and of insoluble enzymes on soluble and insoluble substrates. Rate equations and locus effects are given along with the elementary kinetic and thermodynamic features. Several models are presented in the steady state studies of nitrification in soil, and procedures for the estimation of surface pH in soils are mentioned. Experiments on the enzymatic activities in stored and geologically preserved soils are reported, and the continuing investigation of chitinase and lysozyme activity in adsorbed state on chitin is discussed. A brief summary is given on the study of organic-matter-exhausted soils. B.S.D.

N68-15477*# National Aeronautics and Space Administration, Washington, D. C.
PROBLEMS OF SPACE BIOLOGY. VOLUME 5: DYNAMICS OF THE CEREBRAL BLOOD VOLUME UNDER NORMAL CONDITIONS AND GRAVITATIONAL STRESSES
Yu. Ye. Moskalenko Feb. 1968 193 p refs Transl. into ENGLISH of the book "Problemy Kosmicheskoy Biologii. Tom V. Dinamika Krovenapolneniya Golovnogo Mozga v Norme i pri Gravitatsionnykh Nagruzkakh" Leningrad, Nauka Press, 1967
(NASA-TT-F-492) CFSTI: HC $3.00/MF $0.65 CSCL 06S

The basic mechanisms responsible for compensating changes in the blood volume of the closed cranial cavity are described, based on data obtained by electroplethysmography, which makes it possible to judge the dynamics of the cerebral blood volume directly; and on critical analyses of other experimental material. A detailed assessment is made of some aspects of active and passive compensation of changes during gravitational stresses of more than 1 g, such as are encountered in space flight. Analytical data are also presented on the nature and activity of the basic mechanisms during compensation of periodic fluctuations in the blood volume resulting from cardiac activity, respiratory movements, third-order waves, and vascular reaction of the brain under normal conditions, including longitudinal gravitational accelerations of up to +1 g. To define these mechanisms, the dynamics of the cerebral blood volume as a partly isolated system are examined. M.G.J.

N68-15480# Agricultural Research Service, Ithaca, N. Y. Northeast Branch.
THE ENERGY BUDGET AT THE EARTH'S SURFACE: COMPARISON OF MOMENTUM AND ENERGY BALANCE METHODS OF COMPUTING VERTICAL TRANSFER WITHIN A CROP
J. L. Wright and K. W. Brown Jun. 1967 26 p refs Prepared in cooperation with Cornell Univ.
(Cross Service Order 2-67)
(ECOM-2-67I-1; RR-394; AD-662721)

Measurements of windspeed, air temperature, wet-bulb depression, and net radiation were made at several levels within and above a corn crop. Soil heat flux and incident radiation were also measured. Transfer coefficient distributions were computed separately from the windspeed data by a momentum balance approach, and from the other data by the energy balance method. The agreement between the two methods was better near the top of the crop than near the soil. Drag coefficients computed from the energy balance results were not independent of height within the crop as was assumed in the momentum balance analysis. The low Reynolds numbers for the lower portion of the crop could account for the deviation. The energy balance approach required more measurements, but was easier to apply in calculating the distribution of the transfer coefficient for the computation of the vertical flux of such entities as heat, water vapor, and carbon dioxide within the crop. Author (TAB)

N68-15526# Geoscience, Ltd., La Jolla, Calif.
WHOLE ORGAN FREEZING AND THAWING HEAT TRANSFER AND THERMAL PROPERTIES Quarterly Report, Jul. 1–Sep. 30, 1967
Heinz F. Poppendiek, Norman D. Greene, Rosemarie Randall, Helen G. Furgerson, and James J. Kacirk 30 Sep. 1967 14 p ref
(Contract Nonr-4095(00))
(GLR-57; AD-662673)

A number of freezing experiments were performed with bovine liver samples, using liquid nitrogen and dry ice-acetone as refrigerants. The experimental time-temperature results were compared to predicted values obtained from a numerical analysis for an idealized liver slab. Several improvements in the thermal conductivity apparatus were made. The system involved was checked using water. Also some preliminary thermal conductivity measurements for bovine kidney at room temperature and at -45F were obtained. The heat capacities of bovine suet, heart muscle, and brain were measured at liquid nitrogen temperatures with the thermal gradient calorimeter; preliminary measurements for bovine kidney and pure NRG protein were also obtained. Author (TAB)

N68-15701*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
THE POTENTIAL HAZARD OF STAPHYLOCOCCI AND MICROCOCCI TO HUMAN SUBJECTS IN A LIFE SUPPORT SYSTEMS EVALUATOR WITH ELEVATED CABIN TEMPERATURE

Leonard P. Lotter and Bonnie S. Horstman Wright-Patterson AFB AMRL Sep. 1967 26 p refs Sponsored by NASA and the AF
(Contract AF 33(657)-11716)
(NASA-CR-92557; AMRL-TR-67-43) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Four human male subjects participated in a 6-week simulated aerospace study and were confined under controlled metabolic conditions. The subjects ate a diet composed of fresh foods while exposed to simulated aerospace stress of confinement, wearing an unpressurized MA-10 pressure suit, increased environmental temperature, experimental diet, and minimal personal hygienic conditions. Body and environmental areas were sampled and catalase-positive, gram-positive cocci isolated were tested for production of coagulase, deoxyribonuclease, hemolysin, gelatinase, and utilization of mannitol. The results showed no significant differences in frequency of occurrence of biochemical types among subjects and among environmental areas during the chamber period. There were significant differences in the frequency of occurrence of biochemical types on nose, throat, gingiva, axilla, groin, glans penis, anus, and toe. Though 3 phage types, 29, 6/7/53/83a, and 6, were recovered initially from 2 subjects, only one subject had transmitted a staphylococcus to other subjects and the environment. The subjects remained healthy without any decrease in resistance to infection throughout all the test conditions. Author

N68-15710# Naval Radiological Defense Lab., San Francisco, Calif.
INFLUENCE OF AGE AT EXPOSURE ON SOME PERSISTANT AND LATE EFFECTS OF IRRADIATION WITH FAST NEUTRONS
Dave C. Jones, Garold K. Osborn, and Donald J. Kimeldorf 6 Dec. 1967 32 p refs
(USNRDL-TR-67-121; AD-662222)

In a duration-of-life study, male Sprague-Dawley rats were exposed to 220 rads of fast neutrons as juveniles (1 month of age), young adults (3 months), middle-aged adults (10, 15 months) or as old adult (21 months) and compared with their sham-irradiated littermates at intervals using a variety of criteria of radiation injury. In all 5 age groups, there was a deficit in body weight that persisted throughout life. The magnitude of this deficit was inversely related to age at exposure. Decreased food and water consumption were seen throughout life in the group irradiated as juveniles, and were less affected after exposure at older ages. These consummatory changes appeared related to the changes in body size. An age-associated marked increase in water consumption per unit metabolic size occurred earlier (than in controls) in animals exposed as juveniles or as young adults, but not in the groups exposed at older ages. Proportions of exposed groups with one or more palpable growths were in excess of the proportion for the appropriate controls after exposure at all except the oldest age, in spite of significant life-shortening after exposure at all except the oldest age, in spite of significant life-shortening after exposure at the three younger ages. Proportions of irradiated groups with palpable growths of large size (2.5 cm or more) exceeded those for controls even for the group exposed at 21 months. Thus, for criteria of metabolic injury and of the chronologic advancement of degenerative and neoplastic changes, it appears that exposure at a juvenile age is most effective for most criteria, but that some late effects of irradiation are discernible even after exposure during old age. Author (TAB)

N68-15784*# Philco-Ford Corp., Newport Beach, Calif. Space and Re-Entry Systems Div.
STUDY, STERILIZATION AND STORAGE COMPATIBILITY OF GROWTH MEDIA FOR EXTRATERRESTRIAL USE Final Report
E. R. Walwick, D. E. Gelvin, T. A. Oda, and J. B. Opfell 29 Dec. 1967 67 p refs
(Contract NAS2-4310)
(NASA-CR-73173) CFSTI: HC $3.00/MF $0.65 CSCL 06M

Because of the requirement of dry-heat sterilization for interplanetary spacecraft, an investigation was initiated to assess the scope of the problem presented by the thermal instability of substances important to extraterrestrial life detection experiments. Ninety-four substances were exposed to drastic thermal conditioning. Following heating, thirty-seven of the substances were found to pass preliminary screening tests designed to detect degradation. The substances were individually packaged under vacuum in borosilicate glass ampoules. Before packaging most substances were dried in a vacuum. After drying the substances were placed in ampoules which were flushed with nitrogen, evacuated, and sealed. The thermal processing consisted of two separate 92-hour heating periods at 135°C. After the second thermal treatment, the specimens were examined by a preassigned sequence of physical and chemical tests designed to detect degradation. Candidate substances were selected on the basis of their importance in microbiological growth media, as spore germinating agents, as substrates for metabolic assays, and as substances characteristic of major biochemical classes. Author

N68-15839*# Miami Valley Hospital, Dayton, Ohio. Dept. of Research.
THE POTENTIAL HAZARD OF STAPHYLOCOCCI AND MICROCOCCI TO HUMAN SUBJECTS IN A LIFE SUPPORT SYSTEMS EVALUATOR AND ON A DIET OF PRECOOKED FREEZE DEHYDRATED FOODS
Leonard P. Lotter, Bonnie S. Horstman, and Joseph V. Rack Wright-Patterson AFB, Ohio AMRL Sep. 1967 60 p refs
(NASA Order R-85; Contract AF 33(657-)11716)
(NASA-CR-92648; AMRL-TR-67-18) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Two groups of four human male subjects were confined under controlled metabolic conditions during 28 consecutive days in a Life Support Systems Evaluator. The subjects were exposed to simulated aerospace stress of confinement wearing an unpressurized pressure suit, experimental diet, and minimal personal hygienic conditions. Body and environmental areas were sampled and the catalase-positive, gram-positive cocci isolated were tested for production of coagulase, deoxyribonuclease, hemolysin, gelatinase, and utilization of mannitol. The results showed no significant differences in frequency of occurrence of biochemical types among the subjects or among the environmental areas during the chamber period. There were significant differences in the frequency of occurrence of biochemical types in microbiological specimens from the eye, ear, nose, throat, mouth, axilla, umbilicus, groin, glans penis, and anus. The subjects remained healthy without any decrease in resistance to infection throughout all the test conditions. In concurrent metabolic studies, the physiological, biochemical, and nutritional parameters investigated were all in the normal range of clinical values. Author

N68-15865*# Technology, Inc., San Antonio, Tex. Life Sciences Div.
THE INVESTIGATION OF VERTEBRAL INJURY SUSTAINED DURING AIRCREW EJECTION. PHASE 2a. BASIC SCIENCE EXPERIMENTAL DESIGN AND INVESTIGATION OF DYNAMIC CHARACTERISTICS OF VERTEBRAL COLUMNS CONSIDERED AS AN ENGINEERING STRUCTURE Annual Report, 1 Nov. 1966–31 Oct. 1967
Lawrence S. Higgins, Robert A. Schmall, Harold E. Brown, Rex H. Howard and Judith A. Brockway 31 Oct. 1967 33 p refs
(Contract NASw-1313)
(NASA-CR-92541; TI-67-159-4) CFSTI: HC $3.00/MF $0.65 CSCL 06E

The dynamic strength was determined for 2 vertebrae–1 disc sets of various categories. Details of the basic science experimental design used in this continuing investigation of dynamic characteristics of the human vertebral column as an engineering structure are included. Recent studies include moisture and ash determinations of the segments tested. The results are presented as a series of figures, tables and discussions. Author

N68-15866*# AiResearch Mfg. Co., Los Angeles, Calif.
PHASE 2: PARAMETRIC STUDY OF FLIGHT-INDUCED PULMONARY PATHOLOGY Final Report
James N. Waggoner, Edward C. Wortz, Robert L. Wick, Jr., T. J. Harrington, L. E. Browne et al 28 Jan. 1966 185 p
(Contract NAS2-1597)
(NASA-CR-92540; LS-66-0013) CFSTI: HC $3.00/MF $0.65 CSCL 06E

Pulmonary pathological response of four selected subjects breathing a conditioned atmosphere and then being centrifuged was investigated. Pre- and post-test data consisting of chest X-rays and pulmonary function measurements were collected after conditioning to three test atmospheres with total pressures of 380, 380, and 194 mm Hg abs, and oxygen partial pressures of 180, 367, and 180 mm Hg, respectively. Nitrogen was the diluent in the first 380 mm Hg pressure test; the rest of the atmosphere was water vapor and carbon dioxide. Two test durations, three hours and eight hours, were investigated, and at the end of the conditioning the subjects were exposed to a 6-g transverse acceleration ($+a_x$) for two minutes. Statistically significant results cannot be deduced because of the wide variation in measured parameters and the statistically inadequate number of subjects tested. Atelectasis did not occur, and the severity appears to be a cox function of all variables studied. Author

N68-15867*# Techtran Corp., Glen Burnie, Md.
KINETICS OF DECOMPOSITION OF AMINO ACIDS LABELED WITH C^{14} IN SOILS [KINETIKA RAZLOZHENIYA MECHENYKH C^{14} AMINOKISLOT V POCHVAKH]
V. Rachinskiy, Z. Drabent, T. Mazur, and A. Pel'ttser Washington NASA Jan. 1968 7 p ref Transl. into ENGLISH from Agrokhimiya (Moscow), no. 4, 1965 p 28–30
(Contract NASw-1695)
(NASA-TT-F-11485) CFSTI: HC $3.00/MF $0.65 CSCL 06B

The activity of the $C^{14}O_2$ gas phase liberated by decomposition of various amino acids in soil (C^{14} label on carboxyl group) was studied in a sealed chamber with counters at the ends. The reaction rate for the amino acids studied was: methionine > glycine > phenylalanine > valine > alanine. A sharp maximum was observed on each rate curve. The kinetics of decomposition varied inversely with the concentration of the amino acid in the soil; with high concentration (e.g. 100 mg phenylalanine in 90 g soil), a saturation effect occurred. Author

N68-15899*# National Aeronautics and Space Administration, Washington, D. C.
AEROSPACE MEDICINE AND BIOLOGY: A CONTINUING BIBLIOGRAPHY WITH INDEXES
Dec. 1967 133 p refs
(NASA-SP-7011(44)) CFSTI: HC $3.00/MF $0.65 CSCL 06S

Subject coverage concentrates on the biological, physiological, psychological, and environmental effects to which man is subjected during and following simulated or actual flight in the earth's atmosphere or in interplanetary space. Also included are such related topics as sanitary problems, pharmacology, toxicology, safety and survival, life support systems, exobiology, and personnel factors. Each entry consists of a standard citation accompanied by its abstract. Author

N68-15937*# Naval School of Aviation Medicine, Pensacola, Fla.
EFFECT OF BLOOD pH AND CO_2 TENSION ON THE PERFORMANCE OF THE HEART–LUNG PREPARATION
N. S. Nejad and Eric Ogden 13 Nov. 1967 26 p refs Sponsored in part by NASA
(NASA-CR-92516; NAMI-1025) CFSTI: HC $3.00/MF $0.65 CSCL 6P

When the performance of heart–lung preparations was evaluated by the relationship between stroke work and left atrial pressure, a change of the CO_2 content of the inspired air from zero to 10 per cent caused a progressive decrease in performance. The use of HCl or $NaHCO_3$ allowed for changing the pH and pCO_2 of the arterial blood separately. Arterial blood pH rather than blood pCO_2 appeared to be the decisive factor in mediating this change. Whenever a change of inspired air composition was made in either direction, the new performance level was preceded by a marked overshoot. A fall in arterial pH was accompanied by a slowing of the heart rate. Author

N68-15947# Aerospace Medical Lab. (Clinical), Lackland AFB, Tex. Hematology-Cancer Chemotherapy Section.
CHARACTERIZATION AND CLASSIFICATION OF THE LIGHT CHAIN COMPOSITION OF A MACROMOLECULAR CRYOPRECIPITATING FACTOR
Richard A. Gams, John J. Costanzi, and Charles A. Coltman, Jr. Aug. 1967 18 p refs
(AMLC-TR-67-9; AD-662873)

Several patients were reported to have a form of cryoglobulinemia in which the IgM protein precipitated in the complex with the IgG protein. In certain instances, the light chains of the IgM were of both kappa and lambda types. In one previous instance, the light chains were exclusively kappa type and in another, exclusively lambda type. The IgM-IgG complex from a patient with a mixed form of cryoglobulinemia was studied. The IgM portion was found to be necessary for the formation of the complex. Pooled human IgG could be substituted for the IgG of the patient. The IgM protein had exclusively kappa type light chains, whereas the IgG portion had light chains of mixed kappa and lambda types. It was concluded that thd IgM was an abnormal monoclonal paraprotein that formed a cryoglobulin with the available normal IgG. Author (TAB)

N68-16003# Czechoslovak Academy of Sciences, Prague.
ADAPTATION IN CELL AND TISSUE CULTURES
Emma Holeckova 1967 76 p refs *Its* Vol. 77, No. 8, 1967

Tissue culture methods and their adaptation for cultured cell populations are summarized; also discussed are adaptation studies with animal cells to temperature changes, especially to cold, and laboratory results with cultured animal and human cells are presented. In general it is found that the age of the donor organism is a very important factor in cell adaptability; their adaptation ability decreases with age. Also exposure to light, hypoxia, and to subnormal temperatures damages parts of the cell population during handling, and only cells able to adapt to all those factors survive the transplant. G.G.

N68-16047*# Stanford Univ., Calif. Instrumentation Research Lab.
CYTOCHEMICAL STUDIES OF PLANETARY MICROORGANISMS—EXPLORATIONS IN EXOBIOLOGY Status Report, 1 Apr.–1 Oct. 1967

Joshua Lederberg and Elliott C. Levinthal 1 Oct. 1967 45 p refs
(Grant NsG-81)
(NASA-CR-92556; IRL-1061) CFSTI: HC $3.00/MF $0.65 CSCL 06M

The following studies are reported: (1) *Gas Chromatography and Optical Resolution*—molecular analyses of open-chain amines and cyclic amines, conversion of amino acids to non-polar isothiocyanate derivatives, and effects of coupling agents and N-acyl protecting groups on peptide synthesis; (2) *Mass Spectrometry*—analyses on natural products, and microanalysis of organic solids; (3) *Computer Managed Instrumentation*—development of advanced computer to provide digital interface between experimental equipment and data processing for mass spectrometers, chemical hypotheses, particle cell separation and identification, cell detection in high speed flow system, and thermal chromatography runs; (4) *Prebiological Evolution*—concentration of organic precursors of biological molecules in primitive oceans; and (5) *Pasteur Probe*—proposal to study molecular asymmetry in extraterrestrial life detection. G.G.

N68-16061*# Schwarz Bioresearch, Inc., Orangeburg, N. Y.
DEVELOPMENT OF A LOW RESIDUE DIET FOR SMALL PRIMATES Annual Report, 4 Oct. 1966–3 Oct. 1967
Ralph Shapiro 3 Oct. 1967 82 p refs
(Contract NASw-517)
(NASA-CR-91904) CFSTI: HC $3.00/MF $0.65 CSCL 06C

Experiments were conducted to determine whether a highly defined low residue, liquid diet can maintain squirrel monkeys in a state of good health and nutrition. Of the 20 male monkeys selected, 8 passed through the three-phase transition of switching from a standard stock diet, to several chemically defined powder diets, and then to a liquid diet. Diet acceptance was found to be a key factor in achieving success with the liquid regime. After periods of up to 28 weeks, the results show that squirrels maintained on a 50% (w/v) chemically defined liquid diet have either gained or maintained weight, and appear active and healthy. Diet consumption averaged 76 ml/day, which provided 136 calories, 6.9 g protein, 0.15 g fat as ethyl linoleate, 0.19 g calcium, and 0.15 phosporous. No signs of hair loss, dermatitis, emaciation, or malnutrition were noted. M.G.J.

N68-16080*# Pillsbury Mills, Inc., Minneapolis, Minn.
COMPRESSED FOOD COMPONENTS TO MINIMIZE STORAGE SPACE
Jack R. Durst Natick, Mass. Army Natick Labs. Oct. 1967 74 p
(Contract DA-19-129-AMC-860(N))
(NASA-CR-91879; FL-64; TR-68-22-FL; AD-662060) CFSTI: HC $3.00/MF $0.65 CSCL 06H

The study was originated to design, develop, and demonstrate an integrated feeding system based on a specified number of stable food components which can be stored in a limited space and from which can be prepared a variety of nutritious food items. Information is presented for the preparation of 10 food bars, 4 food sheets and 13 food adjunct cubes. Data are given on these components packed in flexible pouches, some under vacuum, after a thirteen week storage study. Evaluations were carried out on microbiological, physical and organoleptic considerations. Hedonic ratings are shown for 45 meals prepared from these components before and after thirteen weeks storage at 38C using both a nine point 5 neutral scale and a nine point 3 neutral scale. Nutritional values of ingredients used are listed. Author (TAB)

N68-16099 California Univ., Livermore. Lawrence Radiation Lab. Bio-Medical Div.
X-RAY FLUORESCENCE ANALYSIS APPLIED TO BIOLOGICAL PROBLEMS
Lynn R. Anspaugh, John W. Gofman, Ora A. Lowe, and Walter H. Martin 1 May 1967 13 p refs Submitted for publication
Sponsored by AEC
(UCRL-70351; CONF-670321-1) CFSTI: $3.00

A methodology is presented for the X-ray fluorescent analysis of trace elements in human fluids and tissues. The samples are lyophilized, and the resulting powder is pressed into one inch disc shaped wafers which are individually mounted in plastic holders. Lyophilization provides for sample concentrations of from 4 to 10, and for a comparatively contamination and loss free procedure. To eliminate any apparent peaks arising from elements present as contaminants within the spectrograph itself, the artificial scatterer used must be free of the trace element being measured, and must approximate the matrix of the sample to be measured. Since most plastic materials have a matrix similar to that of lyophilized biological materials they are used as holders. The data acquisition and reduction techniques used were designed to minimize questions of erratic behavior of the X-ray generator, positioning devices, and electronic counting circuits. The usual procedure is to analyze several samples (20 to 100) at a time for one element since counting it only once builds up a bias if long term drifts are operative. These procedures have been extensively applied to the analysis of chemical elements in human serum, and levels of concurrence or upper limit estimates have been established for 66 elements. E.J.S.

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N68-15033# International Training Centre for Aerial Survey, Delft (Netherlands).
LOGICAL THOUGHTS ON THE PSYCHOLOGY OF PHOTO-INTERPRETATION
S. A. Hempenius, W. G. L. de Haas, and A. P. A. Vink Mar. 1967 23 p refs *Its* Series B, No. 41

A series of slides is presented to illustrate a multidisciplinary effort to relate ideas on photointerpretation with trends in behavioral and natural sciences. Physiological and psychological theories are advanced on problems pertaining to visual perception, expectations about the visual environment, adaptation of the visual process, stereovision, projection, and the three overlapping and related perceptual activities of expectation, filtering, and observation. The importance of logical deduction and associative thinking in professional photointerpretation is stressed. M.G.J.

N68-15115# Institute for Perception RVO–TNO, Soesterberg (Netherlands).
PHASE SHIFTS IN THE PERCEPTION OF SINUSOIDALLY MODULATED LIGHT
G. S. A. M. van de Ven and J. J. Vos [1967] 22 p refs
(IZF-1967-20; TDCK-49228)

Phase shifts in the visual system were investigated as a function of the parameters: average luminance, wavelength, and frequency. The measurements are not absolute, but relative to the value at a certain luminance level or wavelength. With the luminance as parameter a nearly linear relation between frequency and phase shift is found, except for frequencies below 1 Hz. The slope is dependent on the average luminance. With changing wavelength no significant shifts are found. The results are compared

with related experiments, described in the literature. Several models predicting phase characteristics are discussed. Suggestions are made for a different approach, from which the shifts also at very low frequencies might be calculated. Author

N68-15120*# Serendipity Associates, Chatsworth, Calif.
A DESCRIPTIVE MODEL FOR DETERMINING OPTIMAL HUMAN PERFORMANCE IN SYSTEMS. VOLUME 2: PART A: SYSTEM DEVELOPMENT ACTIVITIES CONCERNED WITH PUTTING MAN IN AN AEROSPACE SYSTEM. PART B: DEVELOPMENT OF MAN-MACHINE SYSTEMS: SOME CONCEPTS AND GUIDELINES
Washington, D. C. NASA Jan. 1968 380 p refs
(Contract NAS2-2955)
(NASA-CR-877, V. 2) CFSTI: HC$3.00/MF$0.65 CSCL 05H

The design and control of each of the identified man-related activities in an aerospace system model are described. Consideration is given to planning and controlling each activity in the system development cycle which pertains to the production of man-related end products such as trained personnel, job aids, and human-engineered interfaces. Each man-related activity is discussed in the context of the overall development cycle objectives which are dependencies upon other activities, demands of other activities, activities interactions, and the process of conducting the activity. The identified man-related activities are described in terms of activity groups. Selected terms are given for the common vernacular of the biotechnology and system engineering community. Tools for synthesizing aerospace systems are included with emphasis on the design and development of the man-related features of man-machine systems. B.S.D.

N68-15196# Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.
CUE-ENHANCEMENT AS A FUNCTION OF TASK-SET
Walter C. Gogel Aug. 1967 6 p refs
(AM-67-18) CFSTI: HC$3.00/MF$0.65

Under flight conditions, as well as in other situations, judgments of the distances between objects may depend upon a variety of possible cues. In this study, the hypothesis was tested that the intention to use a particular cue relation would enhance the effectiveness of that particular cue in determining the resulting perception. For this purpose, a situation was presented in which the apparent depth position of an object in a configuration of objects would differ depending upon which of two possible cue relations (size cues) were used. The results support the conclusion that the perceived depth position of the object differed in the expected directions as a function of the task-set. The data of the study are discussed with respect to the "adjacency principle" which states that cue efficiency is determined by the relative adjacency of objects between which the cues occur. Although the effect of cue-set upon the perception seems to be small compared with that of adjacency, it cannot completely be ignored. Author

N68-15204# Naval School of Aviation Medicine, Pensacola, Fla.
EFFECTS OF PERCEIVED SCORING FORMULA ON SOME ASPECTS OF TEST PERFORMANCE
Lawrence K. Waters 22 Jun. 1967 16 p refs
(NAMI-1010; AD-662392)

The study examined the effects on test performance of systematic variations in the scoring formulas which examinees were told would be used in scoring their tests. Two equivalent 50-item vocabulary tests were constructed. Form A was administered without scoring formula specified to 420 pre-flight students. Three days later Form B was administered to the same groups subdivided six ways, i.e., same instructions as Form A; zero weight for wrongs; 1/4, 1, 2, or 4 points off for wrongs. Increases in the penalty for wrong responses were accompanied by consistent increases in the mean number of omitted items, but the mean number correct remained fairly stable over the various penalties. In general, interest correlations were largest when all items were attempted and smallest when random responses were substituted for omitted items. The scoring formula appropriate to the structure of the items, (R–W/4), was generally superior to the scoring formula appropriate to the penalty that examinees were told would be used in scoring the test. Author (TAB)

N68-15267# Institute for Perception RVO-TNO, Soesterberg (Netherlands).
APPLICATION OF LUCE'S CHOICE AXIOM IN FORM-DISCRIMINATION
W. A. Wagenaar 1967 16 p refs
(IZF-1967-17; TDCK-49339, III)

Luce's choice axiom should be tested for different kinds of stimuli. In the present experiment the axiom is tested for confusion matrices obtained in a form-discrimination experiment. Results show that the error introduced by the choice axiom is relatively small. Author

N68-15306*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
EXTENDED DURATION, RECOVERABLE PRIMATE SATELLITE
Washington NASA Jan. 1968 147 p
(NASA Order R-21-009-014)
(NASA-CR-926) CFSTI: HC$3.00/MF$0.65 CSCL 06K

The results are presented of a brief engineering study of a proposed six-month orbital physiological experiment generally referred to as the Primate Orbital Experiment. In this proposed Apollo application experiment, two live squirrel monkeys would be placed into a low earth orbit, then recovered alive approximately six months later, for examination on the ground. This study includes all spacecraft systems, life support, and instrumentation for an experiment package which could be transported into orbit by an Apollo spacecraft and function autonomously until picked up six months later through rendezvous with a second Apollo spacecraft. Presented are approaches to possible ways of integrating the animal-carrying satellite with Apollo during launch, and feasible life support and instrumentation techniques to maintain the animals alive in orbit for six months. Techniques for retrieval are suggested. Author

N68-15314# Federal Aviation Agency, Washington, D. C. Dept. of Transportation.
TYPE AIRMAN CERTIFICATION AS RELATED TO ACCIDENTS
Everett J. Veregge Oct. 1967 12 p refs
(AM-67-23) CFSTI: HC$3.00/MF$0.65

An analysis of 1964 aircraft accidents, using type of airman certificate as a measure of pilot proficiency, is presented. Data show that student pilots generally have a better accident record than any other of the certification groups. Analysis confirmed that, as light and weather conditions deteriorated, accident rates increased. Also, as the higher level of airman certification was achieved (excluding students) the percentage of accidents decreased. Author

N68-15348# Federal Aviation Agency, Oklahoma City, Okla. Dept. of Transportation.
CROSS-MODALITY MATCHING OF LOUDNESS TO BRIGHTNESS FOR FLASHES OF VARYING LUMINANCE AND DURATION

Mark F. Lewis Aug. 1967 9 p refs
(AM-67-16) CFSTI: HC $3.00/MF $0.65

On occasion pilots must make judgments about the brightness of signal lights during night flight. The current study was directed to determining the relation between brightness and flash luminance and duration without use of a visual comparison stimulus. Each subject adjusted the intensity of a 1000 Hz tone presented nonaurally by earphone until the subject was satisfied that the tone was as loud as the flash was bright. The results showed the intensity of the matching tone increased as a function of both flash luminance and duration. Agreement with Bloch's law was obtained. The critical duration of Bloch's law was shown to decrease as stimulus energy increased. No evidence of Broca–Sulzer maxima was obtained. The results were interpreted as indicating that the Broca–Sulzer effect may only be obtained when a visual comparison stimulus is presented. Author

N68-15540# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
BIOMEDICAL ELECTRONICS
In its Tex. Biann. of Electron. Res. 15 Nov. 1967 p 1–16 refs
(See N68-15539 06-10)
(Grants PHS-GM-11111-04A1; NSF GB-5448X)

Baby chick electrocorticogram research activities are reviewed, and a pattern recognition program is described that uses a computer algorithm to discriminate and classify vitamin deficient chicks. A procedure was developed for the numerical classification of biological taxonomic problems, particularly at the infraspecific level or lower; and the research algorithm strategy for this procedure is detailed. M.W.R.

N68-15652# CBS Labs., Stamford, Conn.
DEVELOPMENT OF AUDIO TRANSDUCER HELMET ASSEMBLY Quarterly Report, 1 Apr.–30 Jun. 1967
Allan J. Rosenheck and Alfred L. Di Mattia Nov. 1967 17 p ref
(Contract DAAB07-67-C-0204)
(ECOM-0204-2; QR-2; AD-662068)

The program objective is the development of an Audio Transducer Helmet Assembly to be used in the Army Air Crewman Helmet. The Assembly includes earphones mounted in attenuating earcups along with auxiliary hardware, wiring and ancillary devices. A further goal is the development of a miniature moving-coil noise-cancelling microphone having improved noise-cancellation characteristics. Study of Mutual Stiffness Coupled (MSC) and Bellows Coupled Enclosures was initiated with an assessment of helmet stiffness requirements. It was found that an APH-5 helmet could be made adequately stiff by attaching two yokes fitting within the helmet. An experimental MSC enclosure was installed and noise attenuation measurements confirmed that the helmet was sufficiently rigid for this purpose. Designs for a practical method of assembling the ear enclosures into the helmet were conceived and evaluated. Work on the Low Frequency Coupled Volume (LFC) included further study of the spring design for mounting the LFC enclosures into the helmet. Several spring types were fabricated and of these, spiral springs appeared most practical and simple to produce. Initial models of the noise-cancelling microphone magnetic circuit were constructed and tested. They indicated the potentiality of considerably higher flux densities. Diaphragm dimensions were computed, a coil design was generated, and calculations of the predicted microphone sensitivity were performed. Author (TAB)

N68-15695# Indiana Univ., Bloomington. Dept. of Psychology.
ELECTRODERMAL AND PLETHYSMOGRAPHIC OR COMPONENTS: REPETITION OF AND CHANGE FROM UCS–CS TRIALS WITH SURROGATE UCS
John J. Furedy (Toronto Univ.) Nov. 1967 14 p refs Prepared in cooperation with Toronto Univ.
(Contract Nonr-908(15))
(TR-21; AD-662030)

For 40 Ss a tone and a light were repeatedly paired (P) in the same order (e.g., tone-light) for 15 trials, after which the 2nd member of the pair (e.g., light) was presented alone as the change trial. For another 40 Ss the repetition consisted of 15 single (S) tone (or light) presentations followed by the light (or tone) as the change trial. The duration of both stimuli and the interstimulus interval (on P trials) was .3 sec. and .75 sec., respectively, while the mean intertrial interval approximated 45 sec. GSR and digital-blood-volume-pulse-change (VPC) were recorded. The GSR habituated reliably and at the same rate to both repeated patterns over trials 1-15, but the VPC did not habituate to either pattern. Change from both S and P repetition produced response increases, but the increase under the P condition was not so pronounced as to inspire confidence in explanations of UCS-CS conditioning in terms of OR reinstatement to change. Author (TAB)

N68-15733*# Terra-Space Corp., Malibu, Calif.
ASSEMBLER—THE FUTURE PROFESSION OF AN ASTRONAUT
A. Nikolayev [1967] 5 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 2, 1967 p 45–47 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92593) CFSTI: HC $3.00/MF $0.65 CSCL 05I

The tasks required of future astronauts during space flights are considered in terms of rendezvous and docking, getting out of the spacecraft, and extravehicular activities. The faultless operation of ground-based stations is stressed, along with the need for intense training of astronauts. M.W.R.

N68-15768*# Philco-Ford Corp., Blue Bell, Pa.
SINGLE EQUIVALENT FORMANT EXTRACTOR SYSTEM
Louis R. Focht Nov. 1967 16 p refs
(Contract NAS12-582)
(NASA-CR-86024) CFSTI: HC $3.00/MF $0.65 CSCL 05J

The Single Equivalent Formant (SEF) is a transformation by which the information bearing parameters of speech are represented with only three parameters, the SEF, the amplitude and the state-of-voicing. The equipment built to extract these three parameters is an approximation of the theoretical transformation and as a result possesses certain performance limitations. However the equipment's simple implementation and small number of parameters considerably reduces the size of the total recognition logic. The utilization of the SEF parameters for recognition purposes requires an apriori knowledge of the perceptually significant features found in the SEF parameters. A total of five such features have been found to date and techniques for their utilization are suggested. The comparison of the usefulness of the SEF parameters with other analyzer techniques is considered. It is pointed out that any such evaluation should ideally be carried out as a comparison of the ultimate potential of each analyzer system. However, in practice this is very difficult in as much as it requires the solution to the general recognition problem for each analyzer system. As an alternate, a simpler technique is suggested that is felt will provide a reasonable and fair performance comparison of different analyzer systems for specific recognition tasks. Specific areas of the recognition task are also pointed out in which superior performance might be expected by the use of SEF techniques as well as those areas in which difficulty might be encountered. Author

N68-15785*# Texas Christian Univ., Fort Worth.
MAGNITUDE ESTIMATION OF PERCEIVED DISTANCE OVER VARIOUS DISTANCE RANGES

Robert J. Vincent, Bill R. Brown, and Malcolm D. Arnoult [1967] 17 p refs
(Contract NAS2-1481)
(NASA-CR-73172) CFSTI: HC$3.00/MF$0.65 CSCL 05J

Thee groups of Qs made magnitude estimation judgments of the apparent distance of a stationary space vehicle under conditions simulating outer space. Psychophysical functions for three stimulus ranges were obtained. The exponents for the "near" and "far" stimulus ranges were nearly 1.0. The power function exponent for the "full" range group was 0.48. The psychophysical scales are compared to JND scales obtained in previous research. The results indicate that in all ranges investigated the power law is an appropriate description of the relationship between perceived and objective distance, but that distance range and the location of the range are important determinants of the psychophysical scale. Author

N68-15827# Atomic Energy Establishment, Winfrith (England). Radiological and Safety Div.
A PLASTIC SACHET DOSIMETER CONTAINING LITHIUM FLUORIDE POWDER FOR SURFACE AND FINGER-TIP DOSIMETRY
C. O. Peabody and H. E. Preston Oct. 1967 22 p refs
(AEEW-R-497) HMSO: 3s 6d

A dosimeter is described, consisting of 30 mg of thermoluminescent lithium fluoride powder contained in a plastic sachet. Measurements of its sensitivity for photons and beta rays are presented and discussed. It is shown to provide a convenient, accurate, and reliable method of measuring directly the finger-tip radiation dose of workers handling radioactive materials, surface doses from such materials, and doses in general operational and experimental work. Author

N68-15878# Institute for Perception RVO--TNO, Soesterberg (Netherlands).
ON THE MEASUREMENT OF PITCH PERCEPTION [OVER HET MECHANISME VAN DE TOONHOOGTE-WAARNEMING]
G. F. Smoorenburg 1967 56 p refs In DUTCH; ENGLISH summary
(IZF-1967-23; TDCK-49473)

This report is directed to the mechanism of pitch and particulary to the importance of the time information in the nerve impulses (or of the periodicity mechanism) for the perception of pitch. In the introduction the most important concepts used in this report are discussed against an historical background. The consequence of the frequency-selective filtering of the basilar membrane for these experiments is trested; it is concluded that, to avoid the effects of the filtering, signals with a narrow bandwidth according to the critical bandwidth or narrower have to be used. With this knowledge an investigation is set up into the precision of the periodicity mechanism. Therefore the just-noticeable difference in repetition frequency of filtered periodical impulses is determined by means of the forced-choice method discussed in appendix I. Then artificial fluctuations are introduced in the impulse intervals to be able to estimate on the basis of an increase of the just-noticeable difference in repetition frequency the magnitude of the internal fluctuations. The standard deviation of the internal fluctuations is found to be 50 μsec. An experiment is discussed which clearly illustrates the importance of the fine structure for the perception of pitch on the basis of the periodicity mechanism. Author

N68-15901*# National Aeronautics and Space Administration, Washington, D. C.
THIRD ANNUAL NASA UNIVERSITY CONFERENCE ON MANUAL CONTROL
1967 435 p refs Conf. held Univ. of Southern Calif., Los Angeles, 1–3 Mar. 1967
(NASA-SP-144) CFSTI: HC$3.00/MF$0.65 CSCL 05H

In the conference proceedings presented, emphasis is placed on display devices, function models, decision processes, computer processing of manual control records, controlled elements, physiological modeling, and advanced modeling techniques. For individual titles, see N68-15902 through N68-15935.

N68-15902*# Systems Technology, Inc., Inglewood, Calif.
A SYSTEMS ANALYSIS THEORY OF MANUAL CONTROL DISPLAYS
D. T. Mc Ruer and H. R. Jex *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 9–28 refs (See N68-15901 08-05)

This paper summarizes the basic elements of a unified theory for the development of displays for pilots of manually controlled vehicles. The theory combines several recent manual control developments in its structure: (1) The vehicle dynamics, environmental distrubances, command structure, and mission criteria are derived in terms of meaningful servo analysis parameters. (2) The "best" or "alternative best" feedbacks for the pilot are derived using the "multiloop feedback selection hypothesis," which includes the human operator's describing functions, remnant, and subjective preferences. (3) Quantitative evaluation of the system performance measures, information bandwidths, and stability margins are made by systems analysis techniques. (4) The required scanning pattern and rates and workload margins are then derived, based on still-tentative pilot monitoring and scanning models. (5) The progression and regression of the level of pilot behavior (e.g., during training, transfer, stress, or equipment failure) are treated by the successive organization of perception theory of manual control skill development, and display concepts to enhance the level of display utilization can be quantitatively evaluated. This theoretical framework provides a paradigm for display development, a rational basis for experimental programs, and a theoretical foundation for analyzing the comparative merits or problems of new operational display systems. Author

N68-15903*# Bolt, Beranek, and Newman, Inc., Cambridge.
TWO DIMENSIONAL MANUAL CONTROL SYSTEMS WITH SEPARATE DISPLAYS
William H. Levison and Jerome I. Elkind *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 29–42 refs (See N68-15901 08-05)

The results of a current study of multi-variable manual control systems are presented. The objectives of this study are to investigate the human controller's behavior in multivariable control situations and to develop models of the controller which take into account both the monitoring and the control functions that he typically performs in such systems. A series of two-variable manual tracking experiments was performed in which subjects were required to view two separated displays and operate two control devices to control the system. Performance was measured as a function of the display separation, the forcing function bandwidth, the task difficulty, and the controlled-element dynamics. Human controller describing functions, eye-movement distributions, and normalized mean-squared tracking error were obtained. A model for the human controller in the two-axis control situation was developed. It was tested against the data and found to be a good predictor of performance. Extensions of this model to higher dimension systems are discussed. Author

N68-15904*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PILOTED SIMULATOR DISPLAY SYSTEM EVALUATION. EFFECTIVE RESOLUTION AND PILOT PERFORMANCE IN THE LANDING APPROACH

Wendell D. Chase *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 43–53 refs (See N68-15901 06-05)

A two-part study designed to determine the quality of a visual display in a fixed cockpit piloted simulator and ways of measuring pilot-vehicle performance is reported. Focused on were: (1) the effective resolution of a typical simulator display relative to that for the real world; and (2) pilots' estimates of range and altitude from the runway threshold and measures of his ability to control the vehicle in the approach and landing. A correlation analysis of the information item (2) was used to indicate the degree of association between those performance measures. The static display characteristics, as measured by the resolution of landolt C-rings, were found to be degraded by as much as a factor of 12 when compared with the real world. A further loss of resolution by approximately one-third of the static resolution occurred with the moving display and was influenced by the apparent motion of the airplane. Range estimates to the runway threshold were in error by about 10%; altitude estimates above the runway threshold were in error by about 20%. Error in range estimates decreased with experience while altitude estimates remained relatively constant. Performace in the landing approach was very similar to that in actual flight and even included a duck under maneuver by each pilot. The termination of the landing approach was at higher rates of descent, but touchdown distance from the runway threshold was about the same as that in actual flight. A correlation analysis between the various measures of altitude-range estimates, and pilot-vehicle landing performance showed the following: (1) that the touchdown error depends on the pilot's ability to judge altitude in the landing approach, and (2) the touchdown error is highly correlated with the integrated altitude error, and the correlation indicates difficulty in estimating the correct altitude to decrease the rate of descent and to initiate the flare. However, the absence of motion feedback, ground effect dynamic forces, and vestibular and kinesthetic cues may be partially responsible for these errors.
Author

N68-15906*# Stanford Research Inst., Menlo Park, Calif.
HUMAN OPERATOR DESCRIBING FUNCTIONS WITH VISUAL AND TACTILE DISPLAYS
James C. Bliss *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 67–79 refs (See N68-15901 06-05)
(Contracts NAS2-2752; NAS2-3649)

In the attempt to develop models of manual tracking behavior that also incorporate characteristics of the physiological systems underlying the responses, techniques are needed to separate the contributions of the individual physiological systems, including sensory, central, or motor functions. Techniques that have been used in the past involve variations in the type of command signal (e.g., transient, periodic, and random), the type of output response (e.g., continuous or discrete), and the vehicle dynamics. The research described in this paper emphasizes varying the sense modality employed (i.e., visual, tactile, or both) with continuous command signals and pure-gain vehicle dynamics. Two experiments are reported. The first experiment compares the describing functions obtained with (1) a visual display, (2) a tactile display, and (3) both displays used simultaneously. The second experiment explores various tactile display conditions.
Author

N68-15907*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
A SYNTHETIC DISPLAY TECHNIQUE FOR COMPUTER CONTROLLED SIMULATOR AND AIRBORNE DISPLAYS
Jack J. Hatfield *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 81–95 refs (See N68-15901 06-05)

Interest in airborne, computer-driven, integrated displays has resulted from the problem of effectively displaying greater quantities of rapidly changing control information. A new concept for implementing computer-controlled simulator and airborne displays is described. This concept employs the synthetic generation of desired instrumentation at the cockpit interface of the man–machine loop utilizing a programmable electronic display system. The synthetic display concept utilized is based on an "electronic animation" technique which allows the cockpit display designer to proceed directly from static (cardboard) instrument mockups to dynamic displays which are simulated in the cockpit by high-resolution closed-circuit monochrome television. Experimental synthetic display hardware is described from the viewpoint of relating the operational capability and flexibility of the "electronic animation" technique. The performance achieved to date is illustrated through photographs of synthetically generated electro-mechanical instrumentation. The potential of the technique for synthesizing experimental displays at lower costs, at higher speed, and in new integrated formats is discussed.
Author

N68-15908*# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
INFLIGHT AND GROUND SIMULATION MEASUREMENTS OF PILOT TRANSFER CHARACTERISTICS IN THE COMPENSATORY ROLL TRACKING TASK
F. D. Newell *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 99–119 refs (See N68-15901 06-05)
(Contract AF 33(615)-3605)

This paper presents a review of a measurement experiment in which pilot transfer characteristics have been determined for a random-appearing forcing function in both ground based simulation and actual flight. Three experienced test pilots were the subjects. The task was compensatory tracking in roll to maintain zero bank angle in the presence of small bank angle disturbances, of which the largest were approximately $\pm 8°$. Two simple single-degree-of-freedom controlled elements were flown in the ground based simulator only, and two six-degree-of-freedom airplane-like configurations with excellent handling qualities were flown both in the simulator and in actual flight. Companion work, not reported herein, has been accomplished by the NASA Flight Research Center with a contract analog, ground-based simulator.
Author

N68-15909*# Westinghouse Electric Corp., Pittsburgh, Pa. Defense and Space Center.
DESCRIBING FUNCTIONS FOR COMPENSATORY TRACKING OF SINE WAVES PLUS NOISE
A. C. Beare and A. Kahn *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 121–135 refs (See N68-15901 06-05)

A study of compensatory tracking was performed on an analog computer simulation to test the application of the superposition theorem to human tracking performance. Four subjects participated in a $4\times4\times4\times3\times3\times2$ analysis of variance design in which the input variables of frequency, amplitude, stick and scope sensitivity, and noise conditions were varied systematically. The performance data of error and stick movement and the ratio of these two measures, that is, the gain, were subjected to an analysis of variance performed on a digital computer. The results showed that the linearity assumption is not a valid assumption. The variable underlying performance is the average rate of stick motion. Using the rate variable, a transfer function was derived which provides an adequate fit between the empirically derived and the theoretically calculated data. The conclusions show that error increases and gain decreases as a direct function of average rate of stick motion and that the presence of noise has an effect similar to that of increasing the rate.
Author

N68-15910*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
A COMPARISON OF HUMAN RESPONSE MODELING IN THE TIME AND FREQUENCY DOMAINS

Lawrence W. Taylor, Jr. *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 137–153 refs (See N68-15901 06-05)

Frequency and time-domain methods of analyzing human control response while performing compensatory tracking tasks are reviewed. Sample linear model results using these methods are compared and discussed. The inherent requirement of constraining the freedom of the form of the pilot models is also discussed. The constraint in the frequency domain consists of smoothing with respect to frequency; whereas, the constraint for the time domain model is more natural and meaningful in that it consists simply of limiting the memory of the pilot model. The linear models determined by both methods were almost identical. The time domain of analysis enables the determination of a nonlinear pilot model. The inclusion of a cubic as well as a linear term accounted for only a small additional part of the pilot's remnant and indicated that only a small portion of the total power of the pilot's output is caused by nonlinearities. The power-spectral density of an ensemble average of the pilot's output is used to determine the upper limit of the amount of power associated with a deterministic response. The indication is that more than half the remnant is stochastic when a linear model is used. Author

N68-15911*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

INFORMATION PROCESSING RATE AS INFLUENCED BY THE DEGREE OF RESPONSE DIFFICULTY: A DISCRETE TRACKING TASK

Daniel L. Baty *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 157–164 refs (see N68-15901 06-05)

This study was designed to investigate the dependence of the information-processing rate on the degree of response, or task, difficulty. The degree of task difficulty was quantified for a series of discrete, random-input tracking tasks. Performance on one-dimensional (1-D) and two-dimensional (2-D) tasks was compared at equal values of task difficulty. Fourteen tasks were used: 9 with 4 target alternatives and 5 with 16 target alternatives. Six subjects performed the self-paced tasks by rapidly touching with a stylus well-defined areas as they were successively illuminated in a random sequence. Performance in terms of the information-processing rate was primarily determined by the degree of response difficulty and the number of target alternatives. Performance in terms of the average time per response, however, was determined primarily by the degree of response difficulty. For this type of task, higher information-processing rates are possible for 2-D tasks than for 1-D tasks because, for a given number of stimulus alternatives and a constant target size, the 2-D grouping has the lower value of task difficulty. Author

N68-15912*# Dunlap and Associates, Inc., Darien, Conn.

A PSYCHOLOGICAL APPROACH TO OPERATOR MODELING IN MANUAL CONTROL

Charles R. Kelley *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 165–180 (See N68-15901 06-05)

The usual engineering models of the human operator employ techniques that were first developed in control engineering to describe and model control mechanisms. If there are ways in which the human operator differs from inanimate control mechanisms that are significant for representing the human operator, the usual form of engineering model would not be expected to include them. Human operators differ from control devices in that they can understand their task and its environment, can remember the past and predict and plan for the future, and can employ these abilities in control. All of these psychological aspects of the human operator are important in manual control, yet all are absent from the usual engineering models of the human operator. A more veridical engineering model of the operator would contain the following: (1) A direct internal representation of the controlled element and its environment (2) Freedom of the internal representation from present time (fast-time operation) so that it can be used to extrapolate and predict controlled element behavior (3) Control action based on such predictions Adapation in such a model would occur automatically as a consequence of changes in the internal representation, reflecting actual external changes. The internal changes would bring about changed predictions, and as a result of the changed predictions, the control action taken would be changed adaptively. An automatic control device containing these three features was patented in 1950 by Ziebolz, Sheridan, Johnson, and this author have employed versions of Ziebolz' controller as a human operator model. Adaptive and optimizing features of such models are examined. Author

N68-15913*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.

RELATIONSHIPS BETWEEN FOURIER AND SPECTRAL ANALYSES

Lawrence W. Taylor *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 183–186 ref (See N68-15901 06-05)

The feasibility of using expressions of the cross- and power-spectral density functions involving Fourier transforms instead of the cross- and auto-correlation functions in spectral human response analyses; is discussed. It is shown that: (1) It is correct to express the cross spectral density as either the Fourier transform of the cross correlation function, or as the product of Fourier transforms. (2) In order to obtain precisely the same results from the two expressions of cross spectral density, it is necessary not to limit the number of lags of the cross correlation function, and to use identical smoothing operations in both cases. (3) When smoothing is not necessary, such as when a sum of sine waves is used as the input, the expressions of Y_p and ρ can be simplified; and when smoothing is necessary, such as when a random signal is used as the input, the expressions for Y_p and ρ cannot be simplified by can still be expressed in terms of Fourier transforms. (4) Care must be taken to assure that an adequate number of degrees of freedom are used in computing the linear correlation coefficient, especially at low frequencies. S.C.W.

N68-15914*# Bunker-Ramo Corp., Canoga Park, Calif.

MANUAL CONTROL SYSTEM PERFORMANCE WITH QUICKENED DISPLAY, STATE VARIABLE DISPLAY, AND DISPLAY GAINS

F. A. Muckler and R. W. Obermayer *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 189–202 refs (See N68-15901 06-05)

(Contract NAS2-3113)

Twelve college subjects performed compensatory tracking with acceleration control dynamics ($0.5s^2$) and a low-frequency forcing function composed of the sum of six sinusoidal components. One group of six subjects performed with a quickened display and the second group of six subjects performed with a state variable display. The state variable display presented system error and system rate error on separate display indices, while the quickened display presented this information combined as the deviations of a single index. All subjects were presented all combinations of two levels of display error gain and three levels of display rate-error gain. Quadratic performance measures were collected to provide information for synthesis of optimal manual control systems under different performance indices. Further, results of a multiple regression analysis, amplitude ratio/phase data, and amplitude distributions are discussed to reflect on display-man-controller performance. Author

N68-15915*# California Univ., Los Angeles.

SENSORY MOTOR ASPECTS OF MANUAL CONTROL OF HIGH INERTIA TRACKING SYSTEMS

Russell L. Smith and John Lyman *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 203–212 refs (See N68-15901 06-05)

A series of experiments were conducted on a high-inertia manual-tracking device (converted 40-mm gun mount) that simulated closely the characteristics of field tracking systems. The principle goals of the studies were to determine the extent to which results derived from research using low- and negligible-inertia tracking simulators could be generalized to high inertia simulators, and to derive optimum display and control configurations for tracking realistic target trajectories. Important theoretical and practical implications were suggested by the experimental results. It was found that tracking performance was facilitated by increasing display magnification, optical magnification (reducing subject-to-display distance), and proprioceptive cues derived from azimuth and elevation movements of the simulator. Reduction in the display field of view and/or addition of displacement aiding velocity control dynamics also significantly improved performance. Contrary to previous research, no differences were observed in performance with pressure and with movable-type controllers for experienced trackers, although the former controller appeared superior during early learning trials. Author

N68-15916*# Michigan Univ., Ann Arbor.
FORCE FEEDBACK COMPENSATION: A NEW CONCEPT FOR IMPROVED MANUAL CONTROL SYSTEM PERFORMANCE
James H. Herzog and Richard W. Pew *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 213 ref (See N68-15901 06-05)

A new concept for improved manual control system performance which considers the use of a force feedback compensation system that restores correspondence between the mechanical feel of a control stick and actual plant dynamics. To accomplish this, a mechanical analog of the differential equation describing the plant is implemented on the control stick. Instead of using the control stick output position as the control variable applied to the plant, a signal proportional to the operator's output torque is employed which provides the appropriate mechanical feel characteristics without adding additional dynamic filtering in the foreward loop. This technique of force feedback compensation was evaluated for the case of control of a lightly dampened second order system. Performance of the compensated system as compared with that of an isometric stick with analog plant dynamics showed that the compensated system was better by a factor of two to three. It is concluded that this concept has applicability in several areas of manual control, and is especially suitable for complex plants where the benefit of supplementary sensory information can greatly improve performance. S.C.W.

N68-15917*# Systems Technology, Inc., Inglewood, Calif.
EFFECT OF SOME CONTROL SYSTEM NONLINEARITIES ON SINGLE LOOP COMPENSATORY TRACKING
Dunstan Graham *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 215–221 refs (See N68-15901 06-05)
(Contract AF 33(615)-1782)

Reported are results of experiments which demonstrate the effects of changes in task variables involved in single loop compensatory tracking of random appearing inputs on human operator performance. On the basis of data presented, it is concluded that the human operator in single loop compensatory tracking of random appearing inputs will tend to linearize the performance of the system when this is possible. Both an adjustment as a high gain positioning servo, and the use of dither, are effective against friction and the combination of friction and preload. With the control velocity limiting nonlinearity, no linearization is possible and performance is degraded. In the experiments described, there was no evidence of self-sustained oscillations because of the nonlinearities. The same was true of other experiments made with controlled elements thought to be likely to produce this pathological behavior. S.C.W.

N68-15918*# University of Southern Calif., Los Angeles.
AN ASYNCHRONOUS PULSE AMPLITUDE PULSE WIDTH MODEL OF THE HUMAN OPERATOR
M. J. Merritt and G. A. Bekey *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 225–239 refs (See N68-15901 06-05)

Described is an asynchronous pulse-amplitude, pulse-width human operator model which produces discrete outputs in response to continuously presented Gaussian random inputs. Computer procedures for the complete identification of all model parameters are also described. Parameters of the model were identified from experimental data taken from one subject in an advanced state of training. Computational results were as follows: (1) The delay time between the model's decision to pulse and the actual event was 200 milliseconds. (2) The pulse amplitude and pulse width models for negative pulses produce better correlations with experimental data than models for positive pulses. (3) The pulse amplitude models for positive and negative pulses are similar, despite considerable asymmetry in pulse amplitude distributions. (4) Human operators utilize some preprogrammed pulse sequences. (5) If the differences between model results and experimental tracking data are viewed as the result of short term human operator variations, then the statistics of the human operator variations are easily determined. S.C.W.

N68-15919*# Cambridge Univ. (England). Applied Psychology Research Unit.
A QUANTAL MODEL FOR HUMAN TRACKING
E. C. Poulton *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 241–246 refs (See N68-15901 06-05)

Studies focusing on the development of a computer program which mimics human tracking inputs whose frequencies extend up to at least 30 cycles per minute are reported. Described are two models, one for pursuit, the other for compensatory tracking, which are proposed for use in mimicing human operators under conditions of high frequency inputs. Primary differences between these two models and models based upon servo theory are: (1) The proposed models are designed to produce data with high frequency inputs which actually mimics man, so that human and programmed ata are indistinguishable. (2) The models are sequential in time rather than continuous. (3) The models use statistical information about the forcing function which man has learned, as well as displayed position and rate information. (4) Separate models are given for pursuit and for compensatory tracking, according to the different tasks which the man faces in the two quite distinct situations. S.C.W.

N68-15920*# University of Southern Calif., Los Angeles.
THE EFFECT OF A RANDOM SAMPLING INTERVAL ON A SAMPLED DATA MODEL OF THE HUMAN OPERATOR
G. A. Bekey, J. M. Biddle, and A. J. Jacobson (Hughes Aircraft Co., Culver City, Calif.) *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 247–258 ref (See N68-15901 06-05)
(Grant NGR-05-018-022)

Reported is an experiment based on a simple analog computer simulation of a sampled data model of the human operator in a one-dimensional compensatory tracking loop with a constant gain. Objectives of the experiment were to determine the effects of a random sampling interval on a sampled data model of the human operator. Two types of data hold, a zero order and a first order, were investigated; and different amounts of randomness were used

for a parametric study. Results showed that: (1) It might be impossible to determine the presence of an internal sampler by examining the human operator's output sepctra if a random sampler is assumed. (2) Assuming a randomly varying sampler, results were compatible with previous studies of human pilot dynamics in compensatory systems, and earlier sampled data models. (3) The feasibility of using sampled data models for the human operator is valid, provided only that the sampling interval includes a reasonable amount of randomness. (4) Attempts to enhance the remnant portion of the human operator's output, and improvement of the signal processing and power spectral analysis, will be important in further determination of the validity of sampled data models for the human operator. S.C.W.

N68-15921*# Illinois Univ., Urbana.
PERIPHERAL VERSUS CENTRAL ADAPTION: SOME PRELIMINARY RESULTS
G. C. Agarwal, B. Berman, P. Loehnberg, and L. Stark *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 261–265 refs (See N68-15901 06-05)
(Contract N00014-67-H-0185)

This paper is devoted to exploring possible decomposition of adaptive mechanisms into those utilizing a variable state of gain or dynamic of the peripheral control system, and those relying upon prefiltering of the preprogrammed, ballistic, intermittent commands which dominate the signal pathways during voluntary rapid movements. The mechanical-impulse technique is put forward as an experimental means of testing the state of the peripheral control system during various types of adaptive changes. Adaptation that takes place via the peripheral system should be reflected in changes in the mechanical constraints of the hand. The experimental results indicate that in the normal mode the peripheral system remains unchaged for positive and negative mechanical impulses. Author

N68-15922*# National Research Council of Canada, Ottawa (Ontario).
STATE OF THE ART IN DEVELOPING MODELS OF SKILLED MOVEMENT
C. B. Gibbs *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 267–279 refs (See N68-15901 06-05)

Following the Bell and Magendie discovery of the proprioceptive pathways, opinion divided sharply on their functions and importance. Two main theories have emerged in physiological psychology. The outflow or motor theory of Helmholtz and his followers asserts that the only factors effective in control are learned patterns of motor valleys to muscles; a release pattern runs its course without proprioceptive influence at high level in the brain. The modern version of the alternative inflow or feedback theory attributes continuous central function to proprioception in controlling movement and maintaining perceptual constancy. Ten young men were tested for their accuracy in making horizontal eye movements toward a visible target and toward the recalled position of a masked target. The latter movements were accurate, and secondary adjustments, made without visual cues, usually reduced the residual errors in primary movements. The subjects were tested both before and after drinking alcohol. Eight different men moved their right forearm in the vertical plane, without visual cues, to effect alinement with their stationary left forearm. Primary movements and their residual errors were highly variable, but the latter were usually reduced by "blind" secondary adjustments. The subjects were tested for the effects of alcohol consumption and sleep deprivation for 36 hours. It is argued that the results cannot be reconciled with outflow theory. A model for the control of movement, based on proprioceptive feedback, is outlined. Author

N68-15923*# Systems Technology, Inc., Inglewood, Calif.
A NEUROMUSCULAR ACTUATION SYSTEM MODEL
D. T. McRuer, R. E. Magdaleno, and G. P. Moore *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 281–304 refs (See N68-15901 06-05)
(Contracts NAS2-2824; AF 33(657)-10835)

Recently both high quality physiological data and human operator describing function data of low variability and large dynamic range have become available. These data lead to control engineering descriptions for neuromuscular actuation systems which are compatible with the available data and which provide insight into the overall human control structure (e.g., the types of feedback systems used for various inputs). In this paper, some of these physiological and human-operator data are briefly reviewed, and a simple neuromuscular actuation system model is presented. The physiological data of interest include recent anatomical and physiological data for the muscle spindle and input-output studies of the muscle. These data indicate that simple linear models can describe the basic behavior of these two elements in tracking tasks. Developed further here is the variation in system parameters as a function of average muscle tension and the role of the muscle spindle both as an equalization element and in its effects on muscle tone. The pertinent human-operator describing function data include the covariation of high- and low-frequency phase data and the describing-function variation of high-frequency phase with tension. The simplest neuromuscular model suggested by and compatible with these data is one in which muscle spindles provide both a feedback function, an operating point or bias adjustment, and at least one command path. Author

N68-15924*# Air Force Systems Command, Wright-Patterson AFB, Ohio. Flight Dynamics Lab.
PUPIL DILATION AS A MEASURE OF WORKLOAD
R. O. Anderson and P. E. Pietrzak *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 305–308 refs (See N68-15901 06-05)

Preliminary results from an experiment designed to determine the feasibility of pupillometrices as a measure of workload are reported. The experiment design consisted of implementing the STI critical task on the analog computer. The compensatory task error display was a horizontally moving dot on the CRT which the subject controlled with lateral movements of the control stick. The subject, a military pilot, was told to keep the dot centered on the scope with a minimum of error. Four specific experiments were performed: (1) time varying λ tracking; (2) fixed λ tracking (various λ values); (3) fixed λ tracking with side task; and (4) error observation only, no other tasks. In these experiments λ was the value of the controlled element pole in the right half plane, and increasing represented an increasingly more difficult task. Results lead to the following conclusions: (1) Pupil dilation is evident in certain manual tracking tasks of increasing difficulty. (2) This dilation is correlated with results of at least one, more or less conventional, workload measurement technique, and is also correlated with task difficulty. (3) The exact cause of this effect is unknown; however, it does not appear to be the sole result of error observation, i.e., the phenomenon appears to be a result of stresses from the combined observation–control task. S.C.W.

N68-15925*# California Univ., Los Angeles.
INHIBITORY CONTROL: CONCEPT FOR A FIRST MODEL
John Lyman and Amos Freedy *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 311–314 refs (See N68-15901 06-05)
(Contract V/005P-9779)

Described is an inhibitory control concept of an adaptive system which makes use of the observed high autocorrelation of manipulator movement states during general task performance.

Objectives of the proposed design approach focus on eliminating the human operator's decision load during control operations of multi-dimensional manipulative devices. It is concluded that: (1) by providing a means to externalize partially the detailed decisions required for skilled movements, the operator can achieved more refined control of the output system; and (2) through continued experience with his particular performance goals, the operator will, in effect, shape the plant function, combined with himself, into an integral unit. S.C.W.

N68-15926*# Massachusetts Inst. of Tech., Cambridge.
SUPERVISORY CONTROL OF MANIPULATION
T. B. Sheridan and W. R. Ferrell *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 315–323 refs (See N68-15901 06-05)
(Grant NsG-107-61)

Described are design concepts for a supervisor controlled remote (tool-object) manipulation system. Primary objectives of the proposed design focus on removing man from the immediate control loop so that he can serve as a supervisor by intermittently setting subgoals for an otherwise autonomous remote system of servos, hands, and a small computer. The proposed approach treats the human operator as a strategic planner and is in contrast to previously proposed inhibitory control approaches. Other differences and similarities between conventional tracking and vehicle control, and the proposed remote manipulation or tool-object control system are discussed. S.C.W.

N68-15927*# Massachusetts Inst. of Tech., Cambridge.
STOCHASTIC MODELING OF HUMAN LEARNING BEHAVIOR
Albert E. Preyss and Jacob L. Meiry *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 327–349 refs (See N68-15901 06-05)

A stochastic model of human learning behavior in a manual control task is described. Regulation of the state of a double integral plant to minimize the integrated absolute error is the operator's task. Subjects given this task were instructed to drive the process from an initial state to the null state using a two-position relay controller and a visual display. A subject is conceptualized in the model as a sequential data processing system. A sensor, a decision maker, and an effector are the three serially connected components making up the system. Each element requires a finite time either to process or transmit information, and thus a delay is incurred between the reception of the visual stimulus and the execution of a motor response. In agreement with known experimental evidence, this delay or reaction time is treated as a sum of random variables. A time delay or reaction time is treated as a sum of random variables. A time delay of random duration thus completely describes the sensor and effector dynamics. Decisions are made on the basis of an a priori estimate of the probability that the control polarity should be switched, given the current state of the plant. Patterns in the subsequent phase trajectory are used as evidence by the decision maker to revise prior estimate. Bayes' theorem is the algorithm employed for the determination of the posteriori probability. Behavior of this model is compared with subject behavior in the motor-skill experiment. The extent of the model's characterization of the time varying random nature of human learning is brought out by this comparison. Also discussed are the applications of the concept of this model to other manual control tasks. Author

N68-15928*# Massachusetts Inst. of Tech., Cambridge.
MANUAL TIME-OPTIMAL CONTROL FOR HIGH ORDER PLANTS
Syozo Yasui and Laurence R. Young *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 351–370 refs (See N68-15901 06-05)

The concept of a switching surface is applied to closed loop, manual, time optimal, bang bang control of high-order systems by visually displaying the instantaneous position velocity error spot and the switching locus simultaneously on the phase plane. Switching locus is a curve describing the intersection between the switching surface and the plane parallel to the phase plane, for example, representing the locus in the instantaneous acceleration plane for third-order plants. The operator's task is to achieve minimum time response by reversing control polarity when the moving state point intersects the moving switching locus. The general procedure is outlined for nth order plants with real poles, and a technique suitable for an analog computer to generate the exact or approximate switching locus is proposed. The second-order plants, $1/s^2$ and $1/s(s+\alpha)$, are presented as preliminary examples, for which the switching loci do not move. The third-order plant, $1/s^3$, is studied in detail as an example of higher order plants. Satisfactory experimental results have been obtained for all examples given. Author

N68-15929*# University of Southern Calif., Los Angeles.
ADAPTIVE FINITE STATE MODELS OF THE HUMAN OPERATOR
E. S. Angel *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 371–379 refs (See N68-15901 06-05)
(Grants NGR-05-018-022; AF-AFOSR-1018-67)

While most of the mathematical models of human operators are based on the operator acting in a continuous manner upon continuous data, this model is based upon the human operator seeing only quantized input data and possessing a small number of internal states. The basic model is shown here, and a scheme by which the threshold levels might be adjusted to make the basic model adaptive is presented. Some preliminary results and suggestions for further research are also presented. Author

N68-15930*# Systems Technology, Inc., Inglewood, Calif.
OBTAINING APPROPRIATE HUMAN PILOT DESCRIBING FUNCTIONS FROM CROSSOVER MODELS AND OPTIMAL CONTROL THEORY
Lee Gregor Hofmann *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 381–384 refs (See N68-15901 06-05)
(Contract AF 33(615)-3652)

Demonstrated is the applicability of optimal control theory in relieving inherent problems associated with the use of crossover models for the human pilot to analyze situations in which the controlled element is not clearly one of the basic types (i.e., K_c, K_c/s, or K_c/s^2). S.C.W.

N68-15931*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF HUMAN TRANSFER FUNCTIONS TO A DESIGN PROBLEM
James J. Adams *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 387–397 ref (See N68-15901 06-05)

An analytical design study was made of a proposed full-scale, manually controlled lunar landing simulator using analytical transfer functions for the pilot control response along with the analytical representation for the mechanisms. The simulator reproduced the lunar environment by supporting five-sixths of the weight of the test vehicle with an overhead cable. The cable was kept directly over the test vehicle by the automatic control of the longitudinal drive mechanism of the simulator. The results showed that the dynamic characteristics of the simulator that could be expected in the actual system were in a range that would influence the response of the manually controlled systems which were to be

tested. When the simulator was put in operation, the results of the analytical study were checked. The simulator was operated with the gain of the longitudinal drive set as high as was feasible with the actual mechanism and with a low gain to determine if this change would affect the pilot's response. The pilots reported that the degraded system was more difficult to control, and the records clearly showed a decrease in system damping with the degraded system. Author

N68-15932*# Ohio State Univ., Columbus.
ASYMPTOTIC STABILITY STUDIES IN SIMULATED CAR FOLLOWING
Robert E. Fenton *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 399–414 refs (See N68-15901 06-05)

A control stick with a built-in tactile aiding device was tested in a simulated car-following situation. The tactile device, or finger, gave the driver of a following car information (i.e. headway and relative velocity) about the state of a lead car. The finger position sensitivity and the range of tactile aiding ratios under which a driver may minimize headway and relative velocity variations are obtained, together with a mathematical model of the display-driver-control stick combination. The corresponding driver vehicle system is shown to be locally, but not asymptotically, stable. Hence, optimum tracking and asymptotic stability do not occur under identical conditions. Asymptotic stability may probably be achieved by compensating the driver vehicle system. To this end, various compensation methods are examined, and models are obtained for the modified system. Insight into the form of the required compensation was gained; however, all of the systems examined were asymptotically unstable. Author

N68-15933*# United Aircraft Corp., East Hartford, Conn.
INTERPRETATION OF PILOT OPINION BY APPLICATION OF MULTILOOP MODELS TO A VTOL FLIGHT SIMULATOR TASK
E. W. Vinje and D. P. Miller *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 415–440 refs (See N68-15901 06-05)

Analytical and flight simulator studies were conducted to develop a mathematical model for interpreting pilot opinion rating and pilot selection of optimum control sensitivity for a VTOL aircraft hovering task. Pilot longitudinal control of a VTOL aircraft hovering in turbulent air was modeled as a coupled, multiloop control task. Control characteristics of the pilot were described by adaptable gain and lead terms and by fixed lags. Pilots performed a simulated hovering task for a variety of VTOL configurations while rms hovering performance data were measured. These data were used to compute the pilot model adaptable parameters for each configuration. Results indicate that variations in longitudinal dynamics and the intensity of pitch-attitude distrubances affected pilot opinion rating but not hovering accuracy. However, increasing the intensity of position disturbances increased hovering error while pilot opinion deteriorated. When pilot opinion deteriorated because of difficulty in controlling pitch attitude, computed pilot lead in the pitch loop increased. The pilot also disliked controlling large position disturbances, but he did not always adapt large lead terms in doing it. There was some indication that the pilot's criterion for selecting optimum control sensitivity when the longitudinal speed-stability and drag parameters were varied may have been to keep his internal pitch-loop gain constant. Author

N68-15934*# Naval Research Lab., Washington, D. C.
MAN–MACHINE SYSTEM EQUALIZATION DETERMINATION AND ITS IMPLEMENTATION
C. L. Tipton *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 441–456 refs (See N68-15901 06-05)

This paper presents a simplified and direct method of systems synthesis of higher order, man–machine control loops. A profile of system feedback is derived which produces a previously selected standard form of closed-loop step response. Details of this design procedure are outlined and, by way of example, the equalization for an eighth order aircraft vertical-rate control loop is determined. Further, through an implementation procedure, the synthesized equalization formulation is executed in terms of the given system structure. Finally, a man–machine experiment compares the conventional and equalized control loop configurations. The results show that the derived equalization effects a 90 percent reduction in both system error and the amount of control manipulation. Author

N68-15935*# Systems Technology, Inc. Inglewood, Calif.
APPLICATIONS OF THE PILOT TRANSITION RESPONSE MODEL TO FLIGHT CONTROL SYSTEM FAILURE ANALYSIS
David H. Weir *In* NASA 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 457–459 refs (See N68-15901 06-05)
(Contract NAS2-3607)

The applicability of the pilot transition model to problems of manual control, where the effective dynamics of the task are time varying with a sudden or instantaneous change between stationary control conditions, is discussed. Emphasized is the possibility of making these transitions easier or more graceful; that is, minimizing the operator control difficulties, resultant vehicle motions, and time to reach a steady state adaptation to the new dynamics. Experimental efforts directed toward testing of the graceful degradation hypothesis in a fixed base simulator are reported. According to the hypothesis, the operator will have the least transition control difficulty and his performance will be best if the difference in the effective controlled elements is minimized before and after transition. A second set of experiments involving lateral directional control of roll angel with aileron and yaw rate with rudder are reported. Preliminary results from these experiments support the graceful degradation hypothesis. It is surmised that results of these studies, together with the previously derived transition response model, will ultimately allow rational design criteria to be specified which may place more load on the pilot in some flight conditions, thereby relieving some of the requirements for augmentation system reduncancy. S.C.W.

N68-15945*# Systems Technology, Inc., Hawthorne, Calif.
STUDY, DEFINITION AND ANALYSIS OF PILOT/SYSTEM PERFORMANCE MEASUREMENTS FOR PLANETARY ENTRY EXPERIMENTS
D. E. Johnston and R. F. Ringland Dec. 1967 182 p refs
(Contract NAS2-3635)
(NASA-CR-73171; TR-169-1) CFSTI: HC $3.00/MF $0.65 CSCL 05H

The analysis and synthesis leading to a definition of an experimental program whereby pilot performance during planetary entry can be predicted is presented. This includes an analysis of the mission to determine the piloting skills required, an examination of the literature to determine the current state of knowledge concerning skill degradation under g-forces, and the definition of an experimental program designed to provide a model predictive of human performance during planetary entry. This program relies on ground-based experimentation (human centrifuge), the results to be correlated with a limited number of in-flight entry experiments. Author

N68-16066 Institute for Perception RVO-TNO, Soesterberg (Netherlands).
MAGNITUDE SCALING OF SHORT DURATION WITH CLOSELY SPACED STIMULI

John A. Michon [1967] 9 p refs
(IZF-1967-19; TDCK-49238)

A fine graduated magnitude scale for temporal duration is derived; it consists of two parts, each of which confirms the power law $\psi = a\ \phi^b$. For intervals shorter than 500 msec the characteristic exponent b is approximately equal to 0.6, for longer intervals b ≈ 1.1. The latter result is in accord with earlier studies. The relation of this transition to similar effects obtained in indirect scaling experiments is discussed. The present results rule out the possibility that these effects are artificial byproducts of the motor response elicted by the indirect methods. Author

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N68-15006# Aerojet-General Corp., Los Angeles, Calif. Space-General Plant.
BENCH SCALE PRODUCTION OF $C_2B_4H_8$ (NIDO-4,5-DICARBAHEXABORANE-8)
Robert E. Williams, J. F. Ditter, J. D. Oakes, and F. James Gerhart 26 Oct. 1967 26 p refs
(Contract Nonr-4381(00))
(TR-15; AD-662029)

The production of C2B4H8 (nido-4,5-dicarbahexaborane-8) was scaled up to approximately 90 grams per week utilizing about 200 grams of B5H9 and excess acetylene. Author (TAB)

N68-15043# Technische Hochschule Hannover (West Germany).
HETEROGENEITY OF ADSORPTIVE BOND OF CARBON MONOXIDE ON THE SURFACES OF PURE IRON AND NICKEL FILMS [HETEROGENITAET DER ABSORPTIVEN BINDUNG VON KOHLENMONOXID AN DER OBERFLAECHE REINER NICKEL- UND EISENFILME]
Klaus Fricke (Ph.D. Thesis) [1966] 62 p refs In GERMAN

Thin nickel and iron films, obtained by ultrahigh vacuum deposition at 77°K and subsequently tempered at 333°K, were exposed to isotopic marked carbon monoxide flow. Mass spectrographic measurements on carbon monoxide absorption and resistance changes of films during molecular absorption showed that: (1) carbon monoxide was stationary adsorbed to nickel at 77°K and to iron almost stationary; (2) carbon monoxide molecules adsorbed to the surface at differing stabilities; (3) molecular adsorption on iron films showed fluctuating exchange tendencies; (4) differences on molecular surface bonding were caused by the heterogeneity of the film surface; and (5) the molecular exchange was a second order reaction. Transl. by G.G.

N68-15146# Washington Univ., Seattle. Dept. of Chemistry.
NEW PREPARATION OF DIFLUOROCARBAMYL CHLORIDE, $ClC(O)NF_2$
Ronald L. Cauble and George H. Cady 1967 5 p refs
(Contract N00014-67-A-0103-0002)
(TR-62; AD-662387)

The compound, ClC(O)NF2 is produced by ultraviolet irradiation of a mixture of oxalyl chloride, (ClCO)2, with dinitrogen difluoride, N2F4. Author (TAB)

N68-15155# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
A RAPID DETERMINATION OF PROTACTINIUM-233: DI-ISOBUTYL CARBINOL AND METHYL ISOBUTYL KETONE EXTRACTION
W. Jenkins, J. W. Mc Millan, and T. B. Rees Oct. 1967 9 p refs
(AERE-AM-105) HMSO: 1s 9d

Protactinium-233, together with protactinium-231 tracer, is initially separated by extraction into di-isobutyl carbinol from 6M hydrochloric/4.5M sulphuric acid solution, followed by back extraction as the fluoride complex. Further purification is achieved by extraction into methyl isobutyl ketone (M.I.B.K.) from 6M hydrochloric acid solution, followed by back extraction as the fluoride complex. This latter extraction cycle is repeated until the necessary purification of the protactinium is attained. The protactinium-233 is determined by gamma spectrometry or beta counting and the chemical yield is assessed by alpha counting the protactinium-231. Author

N68-15203 Technische Hochschule Hannover (West Germany).
ON THE ADSORPTIVE BINDING OF CARBON MONOXIDE ON PURE GOLD FILMS [UEBER DIE ADSORPTIVE BINDUNG VON KOHLEN-MONOXID AN REINEN GOLDFILMEN]
Ekkehard Kramp (Ph.D. Thesis) 1966 157 p refs In GERMAN

Carbon monoxide adsorption on thin gold films, and on glass surfaces was studied by isothermal and electrical resistance measurements in an ultrahigh vacuum environment. Low temperature adsorption enthalpies for glass surface densities θ_{16}=0.05 to θ_{16}=0.2 were 5 to 3 kcal/Mol; a temperature increase to 178°K decreased adsorbed gas about a factor of 20. Carbon monoxide molecular adsorption onto gold film surfaces at 77°K showed enthalpies of 8 to 9 kcal/Mol at low densities, and of 4 kcal/Mol at higher gas densities; a temperature increase to 273°K lowered adsorption tendencies markedly concurrent with molecular motion increase. Transl. by G.G.

N68-15214# Technische Hochschule Hannover (West Germany).
THE REACTION OF HYDROGEN ON NICKEL FILM—ADSORPTION HEATING AND RESISTANCE ALTERATIONS [DIE EINWIRKUNG VON WASSERSTOFF AUF NICKELFILME—ADSORPTIONSWAERMEN UND WIDERSTANDSAENDERUNGEN]
Franz Josef Broecker (Ph.D. Thesis) 1967 85 p refs In GERMAN

Colorimetric measurements of hydrogen adsorption on thin nickel films in a high vacuum of 10^{-10} Torr and at 77° to 273°K were used to determine adsorption heat by evaluating the obtained temperature-time diagrams. Electron microscopic analyses of film surface structures during chemisorption established superposition of the surface adsorption at 273°K by the intrusion of hydrogen atoms into the film interior. Adsorption experiments with the systems nickel/carbon monoxide/hydrogen, and nickel/oxygen/hydrogen also showed increased adsorption heat caused by the hydrogen reaction with the already adsorbed gas molecules. Transl. by G.G.

N68-15223# Bundesministerium fuer Wissenschaftliche Forschung, Bad Godesberg (West Germany).
GALVANOSTATIC TRANSIENTS OF HYDROPHILIC OXYGEN GASDIFFUSION ELECTRODES [EINSCHALT-MESSUNGEN AN HYDROPHILEN SAUERSTOFF/GASDIFFU-SIONSELEKTRODEN]

D. Spahrbier May 1967 30 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-05)

Under galvanostatic conditions the potential of a hydrophilic O_2-gasdiffusion-electrode in alcaline solutions is investigated as a function of time. The following parameters were studied: 1. current density, 2. temperature, 3. KOH-concentration. The experimental results are influenced significantly by these parameters. There is reasonable evidence that the potential transient for moderate KOH-concentrations (about 1n) is influenced by the conductivity change within the fine porous cover-layer due to the reduction current. At increasing KOH-concentrations, current densities and decreasing temperature, however, concentration-polarisation becomes more and more dominating. Author

N68-15289# Technische Hochschule Hannover (West Germany).
THE ADSORPTION OF CARBON-MONOXIDE BY COPPER-FILM UNDER DIFFERENT THICKNESS OF LAYER [DIE ADSORPTION VON KOHLENMONOXID AN KUPFERFILMEN UNTERSCHIEDLICHER SCHICHTDICKE]
Heinz-Gerhard Kock (Ph.D. Thesis) 1967 74 p refs In GERMAN

Copper films ranging in thickness from 70 Å to 650 Å were VAPOR-deposited in ultrahigh vacuum. The electronic properties of the pure films were determined from measurements of the electrical resistance and the photoelectric effect. The dependence of the resistance on film thickness and the mean free electron path were measured. Carbon monoxide layers superimposed on the copper films were studied for effects on resistance, output potential, and mass constant. The photoelectric behavior and the adsorption isotherms were measured and characterized by means of a model. Transl. by K.W.

N68-15323# Naval Ordnance Lab., White Oak, Md.
PARTICLE SIZE EFFECT ON EXPLOSIVE BEHAVIOR OF AMMONIUM PERCHLORATE
Donna Price, A. R. Clairmont, Jr., and I. Jaffe 27 Sep. 1967 56 p refs
(NOLTR-67-112; AD-662033)

The detonation velocity and critical density of ammonium perchlorate (AP) increased, whereas the critical diameter decreased, with decreasing particle size. Relative reaction times varied as the particle diameter. Ideal detonation velocities were unaffected. The regular gap test is recommended for AP and the gradient of its 50% gap pressure vs. loading density curve at higher porosities is shown to be like that of the TNT curve. Author (TAB)

N68-15360# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS
J. F. White *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 135–148 refs (See N68-15351 06-22)

The behavior of zirconium alloy and stainless steel cladding on UO_2 fuel elements was studied in steam and in steam plus air from about 1200°C to the melting point of UO_2. Physical and mechanical properties of the claddings were measured. Dynamic testing of Zircaloy-4 clad UO_2, testing of 50 cm-long Zircaloy-4 clad UO_2 fuel elements, and oxidation of type 304 L stainless steel in air and in steam are described. Oxidation of UO_2 by steam and the thermal conductivity of UO_2 were studied. M.W.R.

N68-15361# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PHYSICO-CHEMICAL STUDIES OF Fe–Cr–Al–CLAD FUEL SYSTEMS
H. S. Edwards and K. M. Bohlander *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 149–151 refs (See N68-15351 06-22)

Reactions which can occur between oxidation resistant Fe–Cr–Al alloys and UO_2 at temperatures from 500° to 1200°C were investigated. Early attempts to apply Fe–Cr–Al base alloys as claddings for UO_2 or for metal UO_2 cermet cores resulted in uranium contamination on the surface during extended periods of high temperature testing; and this was attributed to the reduction of UO_2 by Al that produced uranium diffusion onto the surface. Fueled capsule tests are reported. A Cr diffusion barrier was shown to offer promise for reducing or eliminating U surface contamination when the cores contain stoichiometric UO_2; although the Cr barrier does not impede the outward diffusion of free U already present in substoichiometric cores. M.W.R.

N68-15415# Technische Hochschule Hannover (West Germany).
VAPOR PRESSURE MEASUREMENTS AND EQUILIBRIUM RESEARCH ON TUNGSTEN TRIOXIDE-CHLORINE [DAMPFDRUCKMESSUNGEN UND GLEICHGEWICHT-UNTERSUCHUNGEN AM SYSTEM WOLFRAMTRIOXID-CHLOR]
Richard Juergen Sohnemann (Ph.D. Thesis) 1967 97 p refs In GERMAN

The chlorination reaction of tungsten trioxide was analyzed in the temperature range from 700° to 900°C. It was established that the chlorination balance is expressed by the reaction equation $WO_3 + Cl_2 = WO_2Cl_2 + 1/2\ O_2$. The balance constant was derived from the resulting partial pressures, and equations are presented for determining the temperature dependence of the balance constant. The study includes a critical evaluation of the values obtained for transformation temperature, formation and reaction enthalpy, and reaction entropy. Transl. by K.W.

N68-15450# Air Force Cambridge Research Labs., Bedford, Mass. Solid State Sciences Lab.
SOME OBSERVATIONS ON THE GEL GROWTH OF DOPED AND UNDOPED CALCIUM TARTRATE CRYSTALS
Alton F. Armington, John J. O'Connor, and Mary A. Di Pietro May 1967 23 p refs *Its* Phys. Sci. Res. Papers, No. 325
(AFCRL-67-0304; AD-662875)

Some observations on the gel growth of calcium tartrate crystals are presented, and the results compared with previous work. The effect of neodymium doping on the crystal growth is also included. Crystals over one inch in length were produced, which are believed to be some of the largest ever developed by this method. Author (TAB)

N68-15454# Atomic Energy of Canada, Ltd., Chalk River (Ontario). General Chemistry Branch.
THE DETERMINATION OF RUTHENIUM IN MIXTURES OF URANIUM DIOXIDE AND RUTHENIUM [MESURE DU RUTHENIUM DANS LES MELANGES DE DIOXYDE D'URANIUM ET DE RUTHENIUM]
T. Bruce and R. W. Ashley Sep. 1967 9 p ref
(AECL-2771) Available from Atomic Energy of Canada, Ltd., Chalk River: $0.20

A method was required for determining low concentrations of ruthenium, dispersed as metal or dioxide, in milligram sized samples of uranium dioxide. The uranium dioxide was dissolved in nitric acid and the residue treated with hypochlorite solution to convert the ruthenium to the tetroxide. The volatile ruthenium tetroxide was separated by distillation and determined spectrophotometrically using bathophenanthroline. The standard deviation of the results was ±10% of the ruthenium in the sample. Author

N68-15455# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE CONSTRUCTION AND APPLICATION OF A HIGH TEMPERATURE GOUY SUSCEPTIBILITY APPARATUS
M. Allbutt, R. M. Dell, and D. Northover Oct. 1967 17 p refs
(AERE-R-5542)

The construction of a Gouy susceptibility apparatus is described. Operation in the temperature range 300 to 1300°K is achieved at field strengths to 10,000 oersted. The apparatus is calibrated with mercury cobalithiocyanate and the likely magnitude of various measuring errors is discussed. Results obtained for a sample of uranium monophosphide indicate the applicability of the Curie–Weiss law over the temperature range 130 to 1200°K. A magnetic moment $\mu = 3.7$ B.M., Weiss constant $\theta = 32°K$ and a temperature independent paramagnetic susceptibility $\chi_0 = 42.4 \times 10^{-6}$ are calculated. Author

N68-15470# United Kingdom Atomic Energy Authority, Amersham (England). Radiochemical Centre.
CERIUM (4)—ARSENITE REACTION IN MICRODETERMINATION OF IODINE FOR SPECIFIC ACTIVITY MEASUREMENT
A. Appleby and R. E. Spillett Oct. 1967 12 p refs
(RCC-M-210) HMSO: 1s 9d

The oxidation of arsenious acid by Cerium (IV) salts is catalysed by osmium (VIII) and iodide ion. The kinetics and mechanism of the reaction are complex; however, for small intervals of time, the reaction can be regarded as first order with respect to cerium and to the catalyst. Described is a catalytic method for determining iodide specific activity. The reaction was followed by observing the variation of percentage transmission with time using a simple Evans electroselenium photoelectric colimeter equipped with an Ilford filter. Using this method it is possible to determine iodide ion in the concentration range 5×10^{-3}–1 g/ml. The presence of Cl^- or Br^- does not interfere with the determination. The standard error for the measurement of iodide concentration was in the range 3 to 4%. Advantages of the method are that it affords a rapid, sensitive, accurate, and simple means of estimating specific activities of I-125 and I-131 samples, using quantities of activity of the order of a millicurie. S.C.W.

N68-15475# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
THE DETERMINATION OF RUTHENIUM IN URANIUM CARBIDE–RUTHENIUM AND PLUTONIUM CARBIDE/URANIUM CARBIDE–RUTHENIUM CERMETS
G. J. Weldrick, A. J. Wood, D. Crossley, G. Phillips, and G. W. C. Milner Nov. 1967 19 p refs
(AERE-R-5617) HMSO: 2s 6d

Cermet samples are dissolved by fusing with alkaline sodium peroxide under controlled conditions at 600°C in an alumina crucible. The cooled melt is extracted with water, and the resulting solution is acidified with hydrochloric acid. For the determination of ruthenium, sodium hypochlorite is used to oxidise the ruthenium to the tetravalent state before extracting it with carbon tetrachloride to effect a separation from other sample constituents. Ruthenium is then recovered from the organic extracts with sodium hydroxide containing sodium bisulphite. This solution is acidified with hydrochloric acid and heated to 100°C to produce a stable chloro-complex of ruthenium which is used for the spectrophotometric determination of this constituent at 485 mμ. Ru-103 tracer is employed to correct for any slight losses of ruthenium occurring in the separation procedure. For the complete analysis of UC–Ru samples, controlled-potential coulometry is satisfactory for the determination of uranium after the removal of ruthenium by volatilisation. The conventional method of combustion followed by manometric measurement of the carbon dioxide is suitable for the carbon determination. The precisions for the determination of the individual constituents are ±0.25% for uranium, ±0.5% for ruthenium and ±0.3% for carbon. Author

N68-15479# Washington, Univ., Seattle. Dept. of Chemistry.
A NOVEL SYNTHESIS OF BIS(FLUOROCARBONYL) PEROXIDE
Ralph Czerepinski and George H. Cady Nov. 1967 4 p refs
(Contract N00014-67-A-0103-0002)
(TR-64; AD-662389)

Bis(fluorocarbonyl) peroxide, FC(=O)OOC(=O)F, was produced by ultraviolet irradiation of a mixture of oxalyl fluoride, FC(=O)C(=O)F, with oxygen. Author (TAB)

N68-15498# Naval Research Lab., Washington, D. C.
IMPROVING THE REGENERATION OF CARBONATED MEA SOLUTIONS Final Report
Stanley T. Gadomski and R. R. Miller 9 Oct. 1967 15 p refs
(NRL-6614; AD-662654)

An investigation was made to increase the effectiveness of the CO2 Scrubber, currently used in nuclear submarines, to reduce the CO2 levels in the atmospheres. Redesigns of parts of the present unit could show appreciable increases in efficiency. To approach the desired level of 0.5% CO2 in the submarine atmosphere, a size redesign will be required. The data revealed that a redesign of the stripper on the present size unit could give nearly twice the current stripping efficiency. Author (TAB)

N68-15514# Tohoku Univ., Sendai (Japan). Geophysical Inst.
COMPARISON OF THE MEASURED AND CALCULATED TRANSMISSIONS ON THE ROTATION BAND OF WATER VAPOR Final Report
Giichi Yamamoto and Masayuki Tanaka 1966 32 p refs
(Contract CWB-11375)
(PB-176100) CFSTI: CH $3.00/MF $0.65

Comparison of the measured and calculated transmissions has been made. Measurements are taken from Palmer's experiments in the 20 to 50 micron region and from Stauffer and Walsh's experiments in the 14 to 20 micron region. Calculation of transmission is made from the line strengths based on Schwendeman and Laurie's table and the line widths estimated by Benedict and Kaplan. The results are as follows: The calculated absorption shows a few per cent over-estimation of transmission compared to Palmer's experiments. In order to fit the calculated transmission values to the measured ones by Palmer, it is necessary to increase the H_2O–N_2 collision widths estimated by Benedict and Kaplan by about 20 per cent. Author

N68-15515# Atomic Energy Establishment, Winfrith (England).
CORROSION RATE OF GRAPHITES BY CO_2 AND H_2O VAPOR TAKING INTO ACCOUNT IN-PORE DIFFUSION AND TEMPERATURE GRADIENTS Final Report
E. Wicke, K. Hedden, P. Hugo, and A. Loewe Jan. 1966 66 p refs
(Proj. Dragon)
(DP-391)

Three investigations were conducted on: (1) the reactivity of different graphites, (2) reaction rates of nuclear (G5) graphite with low partial pressures of CO_2 and water vapor in helium, and (3) influence of in-pore diffusion on corrosion rate of graphite with linear temperature gradients. NSA

N68-15518# Rocky Flats Div., Dow Chemical Co., Golden, Colo.
ANALYSIS OF AMERICIUM BY CALORIMETRY
Diana L. Davis and Franklin L. Oetting 13 Apr. 1967 8 p refs
(Contract AT(29-1)-1106)
(RFP-895)

A method for the analysis of americium has been developed and is described in this report. The method is based on the calorimetric measurement of the power emitted by the radioactive decay of americium-241 and correlating this measured power to the amount of americium in the sample. Experimental results show that the calorimetric method is more consistent and more accurate than the emission spectrographic method. Author

N68-15523# Central Electricity Generating Board, Bradwell (England). Nuclear Power Station.
STUDIES OF REACTOR COOLANT CHEMISTRY. REACTIONS INVOLVING METHANE AND HYDROGEN
W. R. Godfrey and P. J. Phennah Feb. 1966 32 p refs
Presented at Libby/Cockcroft Meeting on Graphite Chem., Harwell, England, 25–26 Apr. 1966
(GCM/UK/A-18)

Observations made during routine chemical analyses of Bradwell reactor coolant gas indicated that a relation exists between the concentrations of minor constituents, methane, hydrogen and water vapor. Three separate injections of small quantities of methane, and two injections of hydrogen were made, and the changes in concentrations of the three species were followed. Preliminary examination of the data obtained suggest that radiolytic destruction of methane in Bradwell reactor coolant follows a stoichiometry similar to that reported for pure methane radiolysis. Ethane is a primary product of methane destruction, as is hydrogen. Hydrogen disappears rapidly following injection into the coolant circuit, with the production of water vapor. Methane and ethane are also produced. Author (NSA)

N68-15524# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
GRAPHITE CHEMISTRY Research Newsletter
J. Wright Jan. 1966 24 p
(UK-RN-GC-A7)

Graphite—oxidation studies; Graphite—radiation effects on reactivity to oxygen of, neutron; Neutrons—effects on reactivity of graphite to oxygen; Bromine—effects on reactivity of graphite to oxygen; Boron—effects on graphite oxidation; Graphite—diffusion studies of; Graphite—pore structure from bismuth impregnation; Graphite—carbon-14 labeling of dense; Carbon Isotopes C-14—incorporation into dense graphites; Graphite—strength measurements on degassed; Graphite—radioinduced oxidation by carbon dioxide, studies; Carbon Dioxides—radioinduced reactions with graphite, studies; DIDO Reactors—graphite oxidation studies in; BEPO—graphite oxidation studies in; Radiation—effects on graphite–carbon dioxide reactions; Ultraviolet Radiation—effects on graphite–carbon dioxide reactions; Graphite—adsorptive properties of, studies; Oxygen—adsorption on graphite; Methane—adsorption and reactions on graphite during irradiation; Carbon Dioxides—adsorption and reactions on graphite during irradiation; Graphite—reactions with carbon dioxide of PGA, surface oxides formed in thermal and radioinduced; Calder Hall Reactors—coolant gas chemistry studies in Bradwell; Reactor Coolants—chemistry studies of gaseous, in Bradwell reactors; Protons—effects on carbon dioxide–carbon monoxide; Carbon Dioxides–CO_2–CO, radiolysis by protons; Carbon Dioxides—photolysis of, reactions of oxygen atoms produced in. NSA

N68-15535# Bureau of Mines, Albany, Oreg. Metallurgy Research Center.
LIQUIDUS TEMPERATURES OF TITANIFEROUS SLAGS (IN THREE PARTS). 2: TiO_2–Al_2O_3–FeO–SiO_2–CaO–MgO
Wesley T. Holmes, II, Lloyd H. Banning, Lawrence L. Brown, and Gerald G. Thompson Feb. 1968 21 p refs
(BM-RI-7083)

This report describes the second phase of an investigation aimed at obtaining a wider knowledge of the problems involved in smelting titaniferous magnetites. Liquidus temperature measurements were made on selected synthetic slag compositions in the TiO_2–Al_2O_3–FeO–SiO_2–CaO–MgO system. Both the hot-stage microscope and the strip furnace (melting-holding-quenching technique) were used during test procedure to determine the effects of CaO, MgO, and SiO_2 on the liquidus temperature of slags. The liquidus temperatures of slags studied ranged from 1,241° to 1,900°C. The lowest liquidus temperature for each TiO_2 plus Al_2O_3 plus FeO weight-percent generally occurred when the difference between CaO plus MgO and SiO_2 was less than 12 weight-percent. In this investigation substitution of either CaO or MgO for SiO_2 and MgO for CaO raised the liquidus temperature of more than 50 percent of the reported base slags when TiO_2, Al_2O_3, and FeO contents were held constant. The results of this investigation may serve as guidelines for determining flux requirements in smelting a wide variety of titaniferous magnetite concentrates or ores. Author

N68-15555# Bureau of Mines, Boulder City, Nev. Metallurgy Research Lab.
AN ELECTROLYTIC PROCESS FOR SEPARATING NICKEL AND COBALT
Thomas A. Sullivan, B. E. Barton, and F. R. Cattoir Feb. 1968 17 p refs
(BM-RI-7082)

Refining in a molten salt electrolyte was investigated as a means of recovering nickel containing less than 1 percent and preferably less than 0.2 percent cobalt from nickel products containing up to 5 percent cobalt. Electrolytic separation of nickel and cobalt was accomplished in a molten KCl–LiCl–$NiCl_2$ electrolyte. Nickel containing less than 0.10 percent cobalt was routinely prepared. Factors that influenced the transfer of cobalt to the refined product were the nickel concentration of the electrolyte, the cobalt concentration of the electrolyte, the ratio of nickel to cobalt in the electrolyte, and cathode current densities. A method of recovering the cobalt from the electrolyte was developed. The possibility of preparing high-purity nickel by this process was shown, as well as the preparation of various cobalt–nickel–tungsten alloys. Author

N68-15619# Pennsylvania Univ., Philadelphia. Dept. of Chemistry.
SOLVENT ISOTOPE EFFECTS FOR TRIDEUTEROMETHANOL VS. METHANOL Final Report, Jun. 1963–Oct. 1967
Edward R. Thornton Nov. 1967 8 p
(Grant AF-AFOSR-431-65)
(AFUP-67-1; AD-662879)

Analytical methods were developed for precise isotope effect studies of the solvolysis of alkyl halides in CD_3OH-CH_3OH mixtures, determining the isotope effect for product formation by competition. The products of solvolysis can be isolated from the relatively large volume of solvent, without isotope fractionation, using gas chromatography and special collectors cooled with liquid nitrogen. These products can then be analyzed for the ratio of CD_3 to CH_3 groups present by high-precision mass spectrometric measurements. Precise isotope effect data have not as yet been collected. Author (TAB)

N68-15823# Washington Univ., Seattle. Dept. of Chemistry.
FLUOROCARBONYL TRIFLUOROMETHYL PEROXIDE
Ronald L. Cauble and George H. Cady Nov. 1967 3 p refs
(Contract N00014-67-A-0103-0002)
(TR-63; AD-662388)

The compounds, FC(=O)OOCF3, was produced in small yield by ultraviolet irradiation of a mixture of FC(=O)OOC(=O)F with F2. Author (TAB)

N68-15628# Florida Univ., Gainesville. Dept. of Chemistry.
RESEARCH ON SYNTHESIS OF UNSATURATED FLUOROCARBON COMPOUNDS Final Report
Paul Tarrant, O. J. Stewart, F. G. Drakesmith, D. Sayers, J. Heyes et al Natick, Mass. Army Natick Lab. Mar. 1967 192 p refs
(Contract DA-19-129-AMC-79(N))
(C&OM-33; TR-67-79-CM; AD-662712)

Synthesis of a variety of fluorine-containing compounds was studied. A convenient synthesis of perfluoroallyl halides was developed. Lewis acid catalyzed addition of haloalkanes to olefins resulted in new fluoroolefins. A series of fluorine monomers were prepared for polymerization studies. A number of partially fluorinated norbornadienes were prepared by the reaction of cyclopentadiene with haloolefins and subsequent dehalogenation. Several new fluorinated nitroso monomers were prepared. A series of compounds of the general structure (CH3)3SiCF=CFR were synthesized utilizing organolithium reagents. Alcoholysis of these compounds provides a convenient route to 1,2-difluoroolefins. Several other unsaturated fluoroorganometallic compounds were prepared and their reactions studied. It was found that they could be reacted with carbonyl compounds to produce alcohols which on dehydration gave fluorinated dienes. Author (TAB)

N68-15630# Naval Scientific Technical Information Center, London (England).
THE DETERMINATION OF SULPHUR IN PETROLEUM PRODUCTS
K. Krumbholz and G. Jaeckel Aug. 1967 9 p refs Transl. into ENGLISH from Chem. Tech. (Berlin), v. 17, no. 10, Oct. 1965 p. 619–620
(NSTIC/13106/67; NSTIC-TRANS-1848; AD-662486)

In the fuel industry, the most usual method for the determination of total sulphur in petroleum is the oxidation principle by combustion of the sample in a stream of oxygen or air, followed by determination of the sulphur as sulphate. The extensive field of usefulness and the efficiency of the hydration method of sulphur determination are given. All industrial petroleum products, including low-temperature lignite tar, can be analysed by the hydration method. Besides these good results of sulphur determination by the hydration method, the consequent improvement in productivity compared with the method of oxyhydrogen gas deserves special mention, the improvement being as much as 500%. This is attained by working with minimal sample quantities and the elimination of the tedious preparation of the absorption solution for the analysis of the sulphate. Author (TAB)

N68-15655# Harvard Univ., Cambridge, Mass. Dept. of Chemistry.
ELECTRON DEFICIENT COMPOUNDS, ESPECIALLY THOSE OF BORON Final Report
William N. Lipscomb Nov. 1967 11 p refs
(Contracts DA-19-020-ORD-5054; DA-31-124-ARO(D)-45; Grant-DA-ORD-31-124-61-G33)
(AROD-2575.20-C; AD-662761)

A summary is given of work which was concerned mainly with elucidation of the structures of new boron hydrides and the relation of these structures to reactivity and to rearrangement mechanisms. Concurrent with this work has been a development of both the theory and practice of X-ray crystallography, and developments in valence theory which include studies of magnetic properties of molecules. One of the surprising conclusions is the prediction that the BH molecule is paramagnetic, although it has all of its electrons paired. New molecular orbital methods have produced a theory which is useful for predicting reactivity in borans and carboranes when the reaction involves very few steps and comparisons are made among similar expected transition states in the reaction. Finally the widespread occurrence of cooperative rearrangements is a somewhat unexpected general reaction of polyhedral molecules, and the details vary considerably from system to system. TAB

N68-15674# Ohio State Univ., Columbus. Engineering Experiment Station.
WATER VAPOR IN HIGH-TEMPERATURE CERAMIC PROCESSES
Charles J. Koenig and Robert L. Green (Lennox, Inc., Pomona, N. J.) [1967] 105 p refs *Its* Bull. No. 202
Available from Ohio State Univ., Columbus: $3.00

The divisional reviews include the following topics: historical, heat transfer, carbon and sulfur, oxides, glass, glazes, ceramic–metal systems, structural clay products, whiteware and related materials. Abstracts with subject and author indexes are also presented. The thread of continuity, covering observations ranging from the practices of Chinese antiquity to studies on spaceage hardware, is the chemical action of water at high temperatures, as well as the influence of water, both intrinsically and as modified by the various substances which constitute the working material of the ceramist. Author

N68-15675# Atomic Energy Establishment, Winfrith (England). Reactor Group.
FUNDAMENTAL CALCULATIONS AND ESTIMATION OF ACCURACY IN HEAVY WATER STANDARDS
P. R. Rowland May 1967 26 p refs
(AEEW-M-745) HMSO: 3s 6d

The theoretical relationship between density and heavy water concentration is re-examined and it is shown that a simple linear relationship exists between concentration expressed as weight fraction and reciprocal density. The fundamental constants in this equation are critically reviewed and it is shown that world standards differ by an amount equivalent to 0.05% on Reactor Grade Water. In terms of neutron behaviour this represents 3% of the lifetime of a natural uranium reactor (200 MWD/tonne). The major sources of error in the estimation of heavy water by density determination are analysed and methods to obviate them are enumerated. Author

N68-15681# Los Angeles State Coll., Calif. Dept. of Chemistry.
A PROTON MAGNETIC RESONANCE STUDY OF BORON TRIHALIDE COMPLEXES DIETHYL ETHER
R. Schuster, A. Fratiello, and T. Onak Dec. 1967 4 p refs
(Contract Nonr-3364(00))
(TR-16; AD-662681)

At low temperatures, separate proton resonance signals are observed for bulk ether and ether molecules complexed with the boron halide. The methyl signal separations for the BF3, BCl3 and BBr3 complexes show a trend which is opposite to what one would predict on the basis of electronegativities of the halogen atoms. Author (TAB)

N68-15696# Pennsalt Chemicals Corp., King of Prussia, Pa. Research and Development Dept.
NOVEL TRIS(PHOSPHINATES) OF CHROMIUM(3)
A. J. Saraceno, J. P. King, and B. P. Block Dec. 1967 5 p refs Submitted for publication
(Contracts Nonr-2687(00); N00156-67-C-1783)
(TR-56; AD-662674)

Although tris(phosphinates) of chromium(III) would be expected to be intractable amorphous or crystalline solids built from three-dimensional networks, it was found possible to make coherent films of a series of compounds represented by the general formula (CR(OPRRO)2(OPRRO))x. These products have a variety of physical properties unprecedented for coordination polymers with inorganic backbones. Initial attempts to prepare chromium(III) trisphosphinates by metathesis led to the expected insoluble, infusible powders. Subsequently, however, coherent films of chromium(III) tris(methylphenylphosphinate) were isolated which exhibited properties, such as tensile strength, typical of high-molecular-weight polymers. Subsequently, a general synthetic method was developed and used for the preparation of a series of chromium(III) tris(phosphinates). TAB

N68-15699# Atomic Energy Establishment, Winfrith (England).
X-RAY IRRADIATION OF HELIUM CONTAINING GASEOUS IMPURITIES
G. Nencini Jul. 1966 20 p refs
(DP-447) CFSTI: HC$3.00/MF$0.65

The effects of X-rays on He–CO_2 mixtures were studied and found to be qualitatively the same as the effects of inpile radiation. The extent of the radiolysis is determined by energy transfer from the helium. Yields in the ^{14}C exchange process between CO and CO_2 are proportional to the integrated X-ray dose. NSA

N68-15700# University Coll. of North Wales, Bangor. Dept. of Chemistry.
THE REVELATION OF SMALL-ANGLE BOUNDARIES AND FOREST DISLOCATIONS IN GRAPHITE MONOCRYSTALS
Colin Roscoe and John M. Thomas Feb. 1966 28 p refs Presented at the Libby/Crockcroft Meeting on Graphite Chem., Harwell, England, 25–26 Arp. 1966
(GCM/UK/A-16)

The mosaic structure of single crystals of Ticonderoga graphite has been revealed by etching with oxygen in the presence of minute traces of boric oxide and boric acids. The sub-grain boundaries that separate the crystallites may be composed either of non-basal edge dislocations, or of non-basal screws. Evidence is presented for the occurrence of $|11\bar{2}|/\langle 10\bar{1}0\rangle$ and $|10\bar{1}|/\langle 11\bar{2}0\rangle$ type dislocations that align to produce the small-angle boundaries. Symmetrical, asymmetrical, general, and twist boundaries have been identified. The significance of the occurrence of forest dislocations is briefly discussed. Author (NSA)

N68-15704# Bureau of Mines, Minneapolis, Minn. Metallurgy Research Center.
KINETICS OF THE INITIAL REDUCTION STAGES OF MAGNETITE IN HYDROGEN
Tom N. Rushton and S. E. Khalafalla Feb. 1968 32 p refs
(BM-RI-7080)

Rate minima are encountered in the reduction of magnetite with hydrogen. In a certain temperature zone, the reaction rate decreases with rise in temperature. This is inexplicable by classical kinetic theories; neither is a transition in reduction mechanism suitable for interpreting the observed behavior. This anomaly can be fully explained by hypothesizing two species of chemisorbed hydrogen with different adsorption coefficients and activation energies for adsorption. Competition between two energetic states of adsorption occurs with temperature rise, with the low energy state predominating below the anomalous temperature zone and the high energy state above it. The presence of two possible adsorption sites appears to be characteristic for oxidic adsorbents. Author

N68-15708# Library of Congress, Washington, D. C. Aerospace Technology Div.
FOREIGN SCIENCE BULLETIN, VOLUME 4, NO. 1
Jan. 1968 91 p refs

Papers and surveys on recent research activities are presented. Analytical research on metal particle combustion are reviewed. A method is described for preparing soluble polypyromellitimides from diamines containing bulky polar end groups. A literature survey is presented on the potential uses of hydrocarbon-utilizing microorganisms in mining, nutrition, agriculture, and industry. Surveys are also included on recent developments in mathematics, mechanics, and gallium and indium polychalcogenide systems. Notes are also presented on atmospheric temperature measurements, thermal breakdown of electrical insulation occurring under radiation, bolometer construction, phthalocyanines of rare elements, synthesis of new isotopes and elements, and cybernetics. N.E.N.

N68-15709# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIOACTIVATION ANALYSIS OF SILICON DIOXIDE USING ION-EXCHANGE CHROMATOGRAPHY [RADIOAKTIVATSIONNY ANALIZ DVOUKISI KREMINYA S PRIMENENIYEM IONOOBMENNOY KHROMATOGRAFII]
A. I. Kalinin, R. A. Kuznetsov, V. V. Moiseyev, and V. E. Tsapurnik 24 Apr. 1967 16 p refs Transl. into ENGLISH from An SSSR. Otd. Obshch. i Tekhn. Khim. Radiokhim. Metody Opred. Mikroelementov (Moscow-Leningrad), 1965 p 161–167
(FTD-MT-66-142; AD-662383)

A method is developed for the chromatographic separation of elements into groups suitable for gamma-spectrometric determination in reference to the activation analysis of hyperpure silicon dioxide. Preliminary separation of activated elements into groups suitable for gamma-spectrometric determination allows one to accelerate the analysis and to raise the sensitivity and accuracy of gamma-spectrometric determination. Author (TAB)

N68-15734# Academy of Sciences (USSR), Moscow.
THERMAL CONSTANTS OF COMPOUNDS, ISSUE 2
V. P. Glushko 1966 94 p refs In RUSSIAN
(PB-175628) CFSTI: HC$3.00/MF$0.65

Thermodynamic and physical properties for sulfur, selenium, tellurium, polonium, and their compounds are presented in data tables. The data were derived from a survey of over 700 papers published through 1964. Remarks are given with cross references to studies from which specific data for the tables were obtained. Other tables summarize crystal symmetry, structural characteristics, and ionization potential for the elements and compounds treated. Transl. by E.C.

N68-15740# Rocket Propulsion Establishment, Westcott (England).
THE IONIZATION POTENTIAL AND HEAT OF FORMATION OF THE HYDROXYMETHYLENE RADICAL
I. P. Fisher London Min. of Technol. Nov. 1966 13 p refs
(RPE-TR-66/14) CFSTI: HC$3.00/MF$0.65

The ionization potential of the CH_2OH radical has been determined directly as $< 8.14 \pm 0.15$ eV, giving the heat of formation of the radical as $< -8.4 \pm 3$ kcal mole^{-1}. This latter value has been shown to agree with values determined indirectly. Calculations have been made of the bond dissociation energies in several alcohols, D(R–CH_2OH), and these indicate that the presently accepted value for $GDH_f(CH_2OH)E+B$ may be slightly in error. Author (ESRO)

N68-15749# Ballistic Research Labs., Aberdeen Proving Ground, Md.
SOLUTIONS OF REACTION RATE EQUATIONS PERTAINING TO ELECTRON IRRADIATION OF 4:1 MIXTURES OF N_2 AND O_2
Franklin E. Niles and Edna L. Lortie Sep. 1967 122 p refs
(BRL-R-1372; AD-662061)

One of the Kaneshea computer codes (see AD-424 173) was adapted for use on the Ballistic Research Laboratories Electronic Scientific Computer. Using this modified code, reaction rate equations were solved for the following 15 species: e, NO2(-), O(-), O2(-), O3(-), N2(+), NO(+), O(+), O2(+), N, NO, N2O, NO2, O, and O3. The calculations were made for a 4:1 mixture of N2 and O2 at 1 torr total pressure and 300K. Rate constants as given by Kaneshea and Fowler (see AD-646 975) were used. The solutions are presented as number densities versus time after the start of the irradiating electron beam. A description of the modified code is presented. Author (TAB)

N68-15750# Chicago Univ., Ill. James Franck Inst.
HIGH TEMPERATURE CALORIMETRY OF SOLID IONIC SYSTEMS Final Report, 1 Nov. 1964–31 Oct. 1967
O. J. Kleppa 20 Nov. 1967 8 p refs
(Grant DA-ARO(D)-31-124-G616)
(AROD-5107-13-MC; AD-662756)

A summary is given of investigations in the following areas: ..:id-base properties of oxide melts; enthalpies of formation of ceramic materials; thermodynamics of polymorphic transformations; order-disorder in ceramic materials; thermochemistry of solid solutions. TAB

N68-15751# Academy of Sciences (USSR), Moscow.
THERMAL CONSTANTS OF COMPOUNDS [TERMICHESKIE KONSTANTY VESHCHESTV]
V. P. Glushko 3 Feb. 1966 32 p
(PB-175626; TT-67-62383)

The first section of a handbook dealing with values of thermal constants of inorganic and organic compounds containing no more than two atoms of carbon is presented. Results are included for 265 compounds; and deal with constants such as heat capacity, enthalpy, entropy, dissociation energy, enthalpy and isobaric potential of formation, changes in enthalpy and entropy due to polymorphic transformation, fusion and boiling, vapor pressure at phase transitions, and critical pressures and temperatures. M.W.R.

N68-15790# Aerospace Corp., El Segundo, Calif. Lab. Operations.
CARBIDE SYNTHESIS BY METAL EXPLOSIONS IN ACETYLENE
Eileen Cook and Bernard Siegel Sep. 1967 25 p refs
(Contract F04695-67-C-0158)
(TR-0158(3210-10)-3; SAMSO-TR-67-68; AD-662580)

Thermally stable metal carbides can be synthesized readily by electrical explosion of metals into acetylene. Reasonably high degrees of purity can be obtained under appropriate reaction conditions. An important factor governing the purity of the carbide product is the necessity for dilution of the acetylene reactant with an inert gas; this minimizes the rate of self-pyrolysis of acetylene to graphite and hydrogen. It was shown that explosive vaporization of the metal is not necessary for carbide formation since liquid droplets of the metal react readily with gaseous species derived from acetylene; thus explosive melting suffices. Using this technique, LaC2, TiC, ZrC, NbC, Nb2C, Ta2C, MoC, Mo2C, and W2C were prepared from the respective metals. Of the metals studied, only cobalt failed to form a carbide. Factors involved in the synthesis of specific carbides when the metal forms more than one stable carbide are discussed. Author (TAB)

N68-15810 Polish Academy of Sciences, Warsaw. Inst. of Nuclear Research.
A STUDY BY ISOTOPIC METHODS OF THE PROPERTIES OF ELECTRONIC ACCEPTORS OF α-TRICHLOROMETHYL AMINES [IZOTOPOWE METODY BADANIA WLASNOSCI ELEKTRONO-AKCEPTOROWYCH α-(TROJCHLOROWCO-METYLO)AMIN]
Andrzej Lukasiewicz and Maria Drogowska 1967 29 p refs
In POLISH; FRENCH and RUSSIAN summaries
(Rept.-839/22/C)

Exchange reactions were investigated between salts of α-trichloromethyl amines (A_1), labeled with C^{14}, and solutions of free amines (A_2) in hexadecane ($A_1{}^* \cdot HCl/A_2$; $A_1{}^* \cdot HNO_3/A_2$). It was found that the exchange $A_1 \cdot HNO_3/A_2$ controls the affinity of the A_1 and A_2 amines towards the anion NO_3 (reflecting their electronic acceptor capacity) (a_A), however their basicity did not affect the exchange. In a few instances, the acceptor effect ($a = a_{A_2} - a_{A_1}$) and the basicity effect ($z = Z_{A_2} - Z_{A_1}$) operated in a reversible manner: the amine A_2 repelled A_1 from $A_1 \cdot HNO_3$, but not from $A_1 \cdot HCl$ ($Z_{A_2} < Y_{A_1}$; $a_{A_2} > a_{A_1}$). The affinity of A amines to nitric acid provided data on their acceptor characteristics and made it possible to establish the dependency between these characteristics and the structure of A amines. The methoxy substitution groups in the aromatic nucleus increase the acceptor capacity of A amines. This indicates that the acceptor capacity of aromatic derivatives of α-trichloromethyl A amines results from interactions between CX_2 halogen groups (acceptor electrons) and π-electrons of the aromatic nucleus (donor electrons). The interphase exchange was also studied for tritium in the reaction $A_1 \cdot HCl/A_2{}^*$, where A_2 represents an amine labeled by tritium in the presence of nitrogen, for $Z_{A_2} < Y_{A_1}$. Transl. by E.C.

N68-15814# Naval Research Lab., Washington, D. C.
SURFACE POTENTIALS OF AQUEOUS ELECTROLYTE SOLUTIONS Interim Report
N. L. Jarvis and M. A. Scheiman 10 Oct. 1967 20 p refs
(NRL-6583; AD-662656)

The effect of added electrolytes on the surface potential of water was determined using the radioactive electrode technique. Changes in surface potential were found to vary from +64 mV for Na2SO4 at 1.8m to -180 mV for NaCNS at 7.5m. The Group IA chlorides in water gave surface potential differences that decreased in the order K(+) = NH4(+) > Na(+) > Li(+), and the surface potentials of the Group IIA cations decreased in the order Ba(++) > Sr(++) > Mg(++). At a constant anion concentration of 2m the surface potential differences due to the sodium salts were in the order SO4(--) > CO3(--) > CH3COO(-) > Cl(-) > NO3(-) > Br(-) > I(-) > CNS(-). In general the anion with the smaller hydration energy gave the greatest decrease in surface potential. The magnitude of each surface potential change, however, does not appear to be a simple function of the hydration energy or of some related property. The surface potential changes must involve the orientation and structure of the water molecules at the water/air interface, which may be only partially dependent upon the ionic properties as determined in bulk solution. Author (TAB)

N68-15815# Washington Univ., Seattle.
PENTAFLUOROSULFUR CARBONYL FLUORIDE, PENTAFLUOROSULFUR FLUOROFORMATE AND PENTAFLUOROSULFUR PEROXOFLUOROFORMATE
Ralph Czerepinski and George H. Cady Nov. 1967 34 p refs
(Contract N00014-67-A-0103-0002)
(TR-65; AD-662390)

The compounds SF5CFO, SF5OCFO and SF5OOCFO were produced in low yields by ultraviolet irradiation of the following mixtures, respectively: (1) S2F10 and C2O2F2; (2) SF5OF and C2O2F2; (3) SF5OOSF5, and C2O4F2. Each of the new compounds reacts readily with a solution of sodium hydroxide, and has infrared and 19F NMR spectra in keeping with its structure. Author (TAB)

N68-15844# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
INSTRUMENT FOR STUDYING THE OXIDIZABILITY OF PETROLEUM HYDROCARBONS AT HIGH TEMPERATURES
G. F. Bol'shakov 23 Oct. 1967 8 p refs Transl. into ENGLISH from Vyssh. Ucheb. Zaved., Izv., Neft' i Gaz, no. 9, 1964 p 61–63
(Contract NOw-62-0604-c)
(TG-230-T533; AD-663076)

A method for determining the oxidizability of fuels and lubricants by measuring the absorption of oxygen at high temperatures is described. The instrument used enables readings to be taken at constant pressure, thus avoiding errors due to fluctuations in atmospheric pressure. Author (TAB)

N68-15857*# Techtran Corp., Glen Burnie, Md.
RATE OF NUCLEATION OF THE NEW SOLID PHASE IN THE THERMAL DISSOCIATION REACTION OF MAGNESIUM CARBONATE [O SZYBKOSCI TWORZENIA SIE ZARODKOW NOWEJ FAZY STALEJ W REAKCJ: DYSOCJACJI TERMICZNEJ WEGLANU MAGNEZOWEGO]
Stanislaw Bretsznajder, Jadwiga Leyko, and Aleksander Blum Washington NASA Jan. 1968 11 p refs Transl. into ENGLISH from Roczniki Chem. (Warsaw), v. 35, 1961 p 1477–1486
(Contract NASw-1695)
(NASA-TT-F-11477) CFSTI: HC $3.00/MF $0.65 CSCL 07B

The stages in nucleation reactions, e.g. the formation of $CaCO_3$ from CaO and CO_2, is used as a basis for calculations of the kinetics and reaction rate in such reactions. A formula expressing the relationship between the log of the nucleation rate and the inverse square log of the supersaturation is presented, then applied to the results of earlier experiments on the decomposition kinetics of $CaCO_2$ and the reverse reaction. Author

N68-15859*# Bureau of Mines, Pittsburgh, Pa. Pittsburgh Coal Research Center.
DEVELOPMENT OF AN IMPROVED OXYGEN ELECTRODE FOR USE IN ALKALINE H_2O_2 FUEL CELLS Quarterly Report, 1 Oct.–31 Dec. 1967
31 Dec. 1967 23 p refs
(NASA Order W-12300)
(NASA-CR-92582; Q-6) CFSTI: HC $3.00/MF $0.65 CSCL 07D

A total of 26 preparations were synthesized and shipped to Tyco Laborstories in this quarter. Apparatus for testing activity of cathode catalysts in the reduction of oxygen is in operation now. Selected preparations from amongst the materials synthesized so far are being inducted by different methods and their activities tested. Results of different induction experiments on reduced 3Ni–1Au are presented. None of the induction methods tried so far has led to an improved catalyst. Author

N68-15868*# Techtran Corp., Glen Burnie, Md.
THE INFRARED ABSORPTION SPECTRA OF METAL OXIDES
Ohiko Kammori, Naoharu Yamaguchi, and Kamikita Sato Washington NASA Feb. 1968 10 p refs Transl. into ENGLISH from Bunseki Kagaku, Shinpo Sosetsu (Tokyo), v. 16, no. 10, 1967 p 1050–1055
(Contract NASw-1695)
(NASA-TT-F-11483) CFSTI: HC $3.00/MF $0.65 CSCL 07B

In order to apply in infrared spectrometry to the analysis of nonmetallic inclusion in steel, the identification of corrosion products and the study of surface treatment on steel plate, infrared absorption spectra of 25 kinds of metal oxides were examined in detail. These oxides showed definite correlations between their spectra and crystal structures: (1) Oxides of iron, FeO, α-Fe_2O_3, γ-Fe_2O_3 and Fe_3O_4. (2) CrO_3, PbO, SnO and V_2O_3 give specific absorptions. (3) NaCl type oxides, MgO, CaO, FeO etc., have only one absorption at near 400 cm^{-1}. (4) Spinnel ($MgAl_2O_4$) type oxides have coupling absorption at near 570 and 390 cm^{-1}. (5) Silicon dioxide can be easily distinguished from the mixed sample of FeO, MnO, SiO_2, Cr_2O_3 and Al_2O_3. It was recognized, moreover, that the absorbance, $\log(I_0/I)$, and quantity SiO_2 were linearly correlated. Author

N68-15882# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE GROWING OF SINGLE CRYSTALS OF CALCITE UNDER HYDROTHERMAL CONDITIONS [VYRASHCHI-VANIYE MONOKRISTALLOV KAL'TSITA V HYDROTHERMAL CONDITIONS]
N. Yu. Ikornikova, V. A. Shorygin, and I. A. Vasil'chikova 7 Aug. 1967 10 p refs Transl. into ENGLISH from An. SSSR, Inst. Kristallogr. (Ukrania), no. 4, 1964 p 92–94
(FTD-HT-23-563-67; AD-662852)

It was established (Dokl. Akad. Nauk SSSR 130(3), 610 2(1960) that under the conditions of expts. on the growing of calcite crystals at 400–450 degrees and high pressures, H developed in the system CaCO, NaCl H2O-Fe. The at. H that formed reacted with CO2. Evolution of H, which also took place at 200 degrees, and its reaction with CO2 interfered with the growth of calcite crystals on nuclei: the crystals either did not grow at all, grew too slowly, or were imperfect. Evolution of H was eliminated by growing calcite crystals in a special glass vessel placed in an autoclave, so that contact of the soln. with the walls of the autoclave was prevented. By using this arrangement, calcite crystals with dimensions of the order of 1-2 cm. were successfully grown in various chloride solns. at 150-200 degrees in the dissolution zone temperature differentials of 10-25 degrees, and pressures of 150-200 kg./sq. cm. TAB

N68-15951# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LENINGRAD. UNIVERSITY. HERALD. PHYSICS AND CHEMISTRY SERIES
P. P. Pavinskiy, A. V. Storonkin, S. S. Tolkachev, O. N. Grigorov, K. Ya. Kondrat'yev et al 6 Sep. 1967 181 p refs Transl. into ENGLISH of the Publ. "Vestnik Leningradskogo Universiteta Seriya Fiziki i Khimii" Leningrad, Izd. Leningr., 1964 p 1–141
(FTD-MT-64-359; AD-662773)

Papers are presented on various aspects of atomic physics, electrochemistry, reaction kinetics, quantum mechanics, ion exchange properties, and masers. For individual titles see N68-15952 to N68-15972.

N68-15959# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ION-EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATE. 1: INVESTIGATION OF DEPENDENCE OF ION-EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATE ON CONDITIONS OF ITS OBTAINING [IONOOBMENNYYE SVOYSTVA TSIRKONIL-FOSFATA. 1. ISSLEDOVANIYE ZAVISHIMOSTI IONOOBMENNYKH SVOYSTV TSIRKONIL-FOSFATA OT USLOVIY YEGO POLUCHENIYA]
Ye. A. Materova and P. A. Skabichevskiy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 81–91 refs
(See N68-15951 06-06)

The effects of the precipitation conditions (conditions, acidity, ZrO_2:P_2O_5 ratio, temperature) in the preparation of zirconyl phosphate on its composition and ion exchange properties were studied. From the potentiometric titration curves of zirconyl phosphates which differ in their properties it was shown that the ion exchange capacity of zirconyl phosphate is a function of the

sample composition. Samples having a molar ratio of ZrO_2/P_2O_5 much greater than 1 have smaller number of functional strongly acid ionogen groups with a reduced ability to dissociate and hence a lower ion exchange capacity. Author

N68-15960# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ION-EXCHANGE PROPERTIES OF ZIRCONYL PHOSPHATE. 2: INVESTIGATION OF EXCHANGE OF A SERIES OF SINGLY AND DOUBLY CHARGED CATIONS FOR THE HYDROGEN IONS OF ZIRCONYL PHOSPHATE [IONOOBMENNYYE SVOYSTVA TSIRKONIL-FOSFATA]

Ye. A. Materova and P. A. Skabichevskiy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 93–104 refs (See N68-15951 06-06)

The sorption of zirconyl phosphate of a series of mono- and divalent ions in wide concentration and pH ranges was investigated to establish a relationship between the sorption of these ions and the zirconyl phosphate composition. Samples of zirconyl phosphate having a molar ratio of ZrO_2/P_2O_5 of 1.07, 1.44 and 1.89 were used. The amount of sorption at the same pH and the same solution concentration depended on the zirconyl phosphate sample composition and the nature and the charge of the ion. In samples low in phosphate the absorption curves for the divalent ions differ sharply from curves with samples where the ratio approaches 1; the phosphate-poor samples do not have strongly acid phosphate groups. The sorption of divalent ions decreased in the series: Cu > Zn > Ba > Ca > Mg. The sorption of K, Na, Li, Ca and Ba ions by zirconyl phosphate having the ratio approaching unity obey the principal equations of ion exchange. Plotting the pH vs activity of the metallic ions in acid media gave a straight line with an inclination near theoretical; at higher pH there are deviations. In acid media the exchange constant for $Ba^{++} - Na^{+} = 8.1$, for $Ca^{++} - Na^{+} = 6.4$. Author

N68-15961# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF OXIDIZING POTENTIAL IN SYSTEM CERI, CEPONITRIC ACID, WATER, TRIBUTYL PHOSPHATE [ISSLEDOVANIYE OKISLITEL'NOGO POTENTSIALLA V SISTEME TSERI–TSERO–AZOTNAYA KISLOTA, VODA, TRIBUTILFOSFAT]

I. M. Batyayev and M. S. Zakhar'yevskiy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 105–111 refs (See N68-15951 06-06)

The oxidizing potential of tri- and tetravalent cerium in the solvent nitric acid, water, tributyl phosphate was measured with 1.37 and 1.35 v being found respectively. Author

N68-15962# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF KINETICS OF ELECTRODE PROCESSES IN SYSTEM CHLOROPLATINATE-ION, CHLOROPLATINATE-ION [ISSLEDOVANIYE KINETIKI ELEKTRODNYKH PROTSESSOV V SISTEM KHLORPLATINAT-ION, KHLORPLATINIT-ION]

V. I. Kravtsov and B. V. Simakov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 113–126 refs (See N68-15951 06-06)

The investigation of the equilibrium potentials and stationary i vs ϕ curves corresponding to the system $PtCl_2^{-2}/PtCl_4^{-2}$ was carried out on the smooth platinum electrode in solution xm $PtCl_6^{-2}$ ym $PtCl_4^{-2}$, zm Cl^-, 3m H_2SO_4 (x, y = 1×10^{-3}–1.6×10^{-2} m, z = 1×10^{-2}–1.0 m). It was found that the rates of anodic oxidation of $PtCl_4^{2-}$ ions and cathodic reduction of $PtCl_6^{-2}$ ions are determined by slow discharge steps. Values of the coefficients b_k and b_a and reaction orders by $PtCl_6^{-2}$, $PtCl_4^{-2}$, $PtCl_4^{-2}$ and Cl^- ions for cathodic and anodic processes were established. It is concluded that in the electrode processes it is $PtCl_5^-$ (in the cathodic process) and $PtCl_5^{-3}$ ions (in the anodic process) that take major part at $|Cl^-| \cong 0.4 - 1.0$ m and not the $PtCl_6^{-2}$ or $PtCl_4^{-2}$ ions numerically prevailing in the solution. Author

N68-15963# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISPROPORTIONATION OF HYDROGEN IN THE SYSTEM BENZENE-ETHYL AND ISOPROPYL ALCOHOL [DISPROPORTSIONIROVANIYE VODORODA V SISTEME BENZOL-ETILOVYY I IZOPROPILOVYY SPIRT]

B. N. Dolgov, T. V. Nizovkina, K. A. Nessler, and I. M. Stroyman *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 127–135 refs (See N68-15951 06-06)

On a nickel catalyst with starch at a temperature of 220–222°C, a benzene:alcohol ratio of 1:9, and a rate of transmission of the initial mixture of 12 ml/hr (over 35–38 ml of catalyst) the hydrogenation of benzene by ethyl alcohol proceeds with yield of 29% (of theoretical) of cyclohexane. On the same layer of catalyst, at a temperature 200°C, a benzene:alcohol ratio of 1:8, and a rate of transmission of 6 ml/hr benzene is hydrogenated by isopropyl alcohol with a yield of 35% (of theoretical) of cyclohexane. During the hydrogenation of benzene by isopropyl alcohol, besides the basic reaction of hydrogenation of the benzene by the hydrogen of alcohol there also occurs condensation of acetone into mesityl oxide and phorone, with their subsequent conjugate hydrogenation into methylisobutyl and diisobutyl ketones. Author

N68-15964# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THIN LAYER CHROMATOGRAPHY OF 2, 4-DINITROPHENYL HYDRAZONES OF ISOMERIC KETONES [TONKOSLOYNAYA KHROMATOGRAFIYA 2, 4-DINITROFENILGIDRAZONOV IZOMERNYKH KETONOV]

Z. A. Shevchenko and I. A. Favorskaya *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 137–144 refs (See N68-15951 06-06)

The chromatography of 2,4-dinitrophenlhydrazones of isomeric ketones C_5 and C_6 on plates with an unfixed layer of aluminum oxide was studied. For the separation of all possible pairs (21 pairs) of 2,4-dinitrophenylhydrazones of ketones, one- and two-dimensional chromatography was used. Satisfactory separation was achieved for 16 pairs of 2,4-dinitrophenylhydrazones. The combinations of 2,4-dinitrophenylhydrazones of methyl-n.-butylketone-methylisobutylketone, pinacolin-ethyl-n-propylketone, pinacolin-ethylisopropylketone, methylisopropylketone–diethylketone failed to be separated. The dependence between the structure of ketones and the data of R_f values of corresponding 2,4-dinitrophenyl-hydrazones was established. Author

N68-15965# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SPECTROPHOTOMETRIC INVESTIGATION OF ASCORBINATE COMPLEXES [SPEKTROFOTOMETRICHESKOYE ISSLEDOVANIYE ASKORBINATNYKH KOMPLEKSOV] ASKORBINATNYKH KOMPLEKSOV]

K. P. Stolyarov and I. A. Amantova *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 145–156 refs (See N68-15951 06-06)

Ascorbinate complexes are formed by the majority of elements Mo, W, Mn, Fe, Co, Ni, Os, Re. Changes are observed in the absorption spectra of solutions of simple salts. Light absorption

strongly increases in the 320–340 mμ region; this is connected with a shift of the absorption band of ascorbic acid into the longwave region (for all ascorbinates); new maxima of light absorption appear (W, 770 mμ; Mn and Co, 380–390 mμ; Os, 400–420 mμ), maxima in the visible part of spectrum are increased and somewhat displaced into the long-wave region (Cr, Co, Ni), and the maximum in the solution of bismuth disappears. Author

N68-15966# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
OBTAINING THE DIHYDRATE OF ALUMINUM OXIDE [POLUCHENIYE DIGIDRATA OKISI ALYUMINIYA]
Ye. A. Bulashevich and S. S. Tolkachev *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 157–159 refs (See N68-15951 06-06)

This paper presents a method of preparing aluminum oxide dihydrate by a reaction between powdered aluminum and water in the presence of sodium hydroxide. Chemical and X-ray analyses of the reaction product prove the existence of aluminum oxide dihydrate. Author

N68-15969# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON CERTAIN CHEMICAL PROPERTIES OF BORON PHOSPHIDE [O NEKOTORYKH KHIMICHESKIKH SVOYSTVAKH FOSFIDA BORA]
I. Yu. Andreyeva and G. V. Yefremov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 173–176refs (See N68-15951 06-06)

A study of the behavior of boron phosphide in acids, oxidizing media, oxygen, nitrogen, and chlorine has shown that its reactivity at 102–288°C is highly dependent upon the grain size: coarse-grained boron phosphide is much more chemically stable than fine-grained; at room temperature it does not react with acids at all. In boiling acids and liquid oxidizing media, coarse-grained boron phosphide dissolves at a much lower rate than fine-grained. The latter begins to oxidize in air at 550–560°C, the former at 740–750°C. At 800°C, boron phosphide, regardless of grain size, transforms into a white residue. This residue contains 9.0% boron and 26.9% phosphorus, with silicon, magnesium, and aluminum impurities, and consists of BPO_4. Boron phosphide oxidized in oxygen behaves in the same manner. In nitrogen, the fine-grained phosphide dissociates at 800–810°C, the coarse-grained at 880–890°C, with precipitation of red phosphorus. Boron phosphide reacts with chlorine at 550–560°C or 800–810°C, again depending on grain size. The reaction proceeds rapidly and yields boron and phosphorus chlorides and a small quantity of white residue consisting of BPO_4. Author

N68-15970# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE CHEMICAL COMPOSITION OF BORON PHOSPHIDE [OPREDELENIYE KHIMICHESKOGO SOSTAVA FOFIDA BORA]
I. Yu. Andreyeva and G. V. Yefremov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 177–180 refs (See N68-15951 06-06)

The following method for the chemical analysis of boron phosphide is suggested. The boron phosphide is chlorinated at 560°C (fine grained) or 810°C (coarse grained) and the boron and phosphor chlorides obtained are absorbed in water. The remainder consisting of BPO_4, is converted into soluble form by fusing it with a mixture of Na_2CO_3 and $NaNO_3$. The boron and phosphorus in the obtained solutions are then determined by conventional methods. The boron and phosphorus contents in coarse-grained boron phosphide determined by the above method varied from 25.0 to 26.9% and from 73.2 to 75.3%, respectively. Corresponding values for fine-grained phosphide varied from 25.1 to 26.6% and from 73.0 to 74.4%. The stoichiometric content is 25.9% boron and 74.1% phosphorus. Author

N68-15971# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF FREE BORON AND PHOSPHORUS IN BORON PHOSPHIDE
I. Yu. Andreyeva and G. V. Yefremov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 181–185 refs (See N68-15951 06-06)

A method for determining elementary boron and phosphorus impurities in boron phosphide is suggested. Free boron and phosphorus are extracted by the treatment of boron phosphide with a mixture of 25 cm^3 H_2O_2 and 0.5 cm^3 HNO_3, a mixture which will not dissolve boron phosphide. The phosphorus in the solution is then oxidized to PO_4 by the iodine solution in potassium iodide. The error of boron and phosphorus determination by this method is approximately 1%. Author

N68-15972# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
KETONIZATION OF PRIMARY ALCOHOLS [KETONIZATSIYA PERVICHNYKH SPIRTOV]
V. A. Komarov and P. V. Maslov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 187–189 refs (See N68-15951 06-06)

It was shown that normal alcohols C_3–C_{10} react with ferric oxide giving symmetrical ketones and esters. The effect of molecular weight was studied and apparent activation energies were calculated. Using butanol-1 the adsorbtion characteristics of reactants were studied by investigating the reactions of binary mixtures of butanol-1 with nitrogen and the reaction products. Author

N68-15992# National Bureau of Standards, Washington, D. C.
TABLES OF MOLECULAR VIBRATIONAL FREQUENCIES, PART 2
Takehiko Shimanouchi (Tokyo Univ.) Oct. 1967 43 p refs (NSRDS-NBS-11, Pt. 2) CFSTI: HC $3.00/MF $0.65

This report contains fundamental vibrational frequencies of 54 molecules together with vibrational assignments, sources of data, brief comments, and citations of references. The fundamental frequencies are obtained mainly from the infrared and Raman spectra. When these are not available, other experimental data such as microwave results are taken into account. The selection of vibrational fundamentals from observed data is based upon careful studies of the spectral data and comprehensive mathematical analyses. These tables were designed to provide a concise summary needed for the computation of ideal gas thermodynamic properties. They may also provide a convenient source of information to those who require vibrational energy levels and related properties in molecular spectroscopy, analytical chemistry, and other fields of physics and chemistry. Author

N68-16019# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
THE DISSOLUTION AND MOBILITY OF HYDROGEN IN COPPER. A QUALITATIVE INVESTIGATION
M. Cazeds, A. Lucasson, and P. Lucasson Feb. 1967 32 p refs Transl. into ENGLISH from Mem. Sci. Rev. Met. (Paris), v. 63, no. 10, 1966 p 835–848 Presented at the joint meeting of Deut. Ges. fuer Metallkunde and Soc. Franc. de Met., Baden-Baden, West Ger., 1 Jun. 1966
(AERE-TRANS-1083) HMSO: 4s 6d

Three complementary studies on the mechanisms of hydrogen movement in copper are described (electrical resistivity, electron microscopy, and mass spectrography). It was determined that: (1) At high temperatures (T>340°C) hydrogen dissolves in copper and migrates in an intrinsic manner (probably as an interstitial proton) without the aid of lattice defects, and diffusion occurs. (2) At temperatures below −100°C, hydrogen dissolves and diffuses in copper at a slow rate (as shown by the existence of a slight desorption peak near 300°C in degassing experiments after simple contact between the metal and the gas); however protons frozen in the crystal lattices by quenching from high temperatures are mobile above −140°C. (3) Between −140 and +340°C, hydrogen does not exist as free protons in the metal. Trapping and release by impurities are found at about −60°C. E.C.

N68-16022# Atomic Energy Establishment, Winfrith (England).
THE INFLUENCE OF MASS TRANSFER ON THE KINETICS OF GRAPHITE OXIDATION BY LOW CONCENTRATIONS OF OXIDISING IMPURITIES IN AN INERT CARRIER GAS
L. Valette and J. York Apr. 1966 54 p Presented at CNRS Intern. Seminar on Transport Phenomena with Phase Change in Porous or Colloidal Mediums, Paris, 18–20 Jun. 1966
(Proj. Dragon)
(DP-419)

Experimental investigations are carried out to study the influence of molecular diffusion and forced convective flow in order to confirm the expressions of mass transfer derived mainly from boundary layer considerations similar to those in heat transfer. Average and local mass transfer coefficients are measured in laminar and turbulent flows in circular channels with different geometries. Author

N68-16059# California Univ., Riverside. Dept. of Chemistry.
AN IMPROVED SYNTHESIS OF 1,7-$C_2B_5H_9$
Gary B. Dunks and M. Frederick Hawthorne 15 Dec. 1967 10 p refs Submitted for publication
(Contract Nonr-443(00))
(TR-3; AD-662684)

Pyrolysis of B7C2H13 and its C-methyl derivatives at low pressures in a flow apparatus operating at 360C affords the corresponding B6C2H8 carborane derivative in 50-60% yield. Author (TAB)

N68-16065# Metaalinstituut TNO, Delft (Netherlands).
TEST METHODS AND RESULTS FOR 8 SAMPLES OF ALKALI-FREE STEAM CLEANING AGENTS AND 9 SAMPLES OF ALKALINE LACQUER AND GREASE REMOVING AGENTS [DE KEURING VAN 8 MONSTERS VAN ALKALIVRIJE STOOMREINIGINGSMIDDELEN EN 9 MONSTERS VAN ALKALISCHE ONTLAK- EN ONTVETTINGS-MIDDELEN EN DE AANPASSING VAN DE KEURINGSME-THODIEK]
M. J. Reidt 16 Oct. 1967 26 p
(M-67-708; TDCK-49435-3)

The alkali-free agents are for use in steam cleaning machines for the cleaning of ferrous and nonferrous metals. The alkaline agents are used in hot water baths to clean steel parts of vehicle undercarriages. Tests were conducted to determine the following qualities in order to update existing Dutch specifications: (1) appearance, particle size, composition, and packaging; (2) cleansing effectiveness or capacity to remove grease or lacquer; (3) corrosive properties and pH values; (4) solubility in distilled and hard water; (5) surface tension and rinse-off with water; and (6) foaming action. Results of the tests and comparative ratings of the products are presented. Transl. by K.W.

N68-16069# Technische Hogeschool, Eindhoven (Netherlands).
SOME PROBLEMS ENCOUNTERED IN HIGH RESOLUTION GAS CHROMATOGRAPHY
Carolus Alfonsus Cramers (Ph.D. Thesis) [1967] 138 p refs
CFSTI: HC $3.00/MF $0.65

Consideration is given to improving the accuracy and sample requirements of injection systems for use with high efficiency, open hole tubular columns, and to developing methods of decreasing the sample requirements for identification. The theoretical influence of the injection procedure is discussed in relation to both the resolution and the accuracy of qualitative analysis to be obtained with high resolution columns. Design principles are proposed for a stream-splitting sample device to be used with small bore columns, and for direct sampling devices to be used with capillary columns. The potential value of accurate retention data in the characterization of volatiles is emphasized. The possibilities of pyrolysis gas chromatography (PGC) as a tool for characterization and structure elucidation of volatile organic substances are assessed, and the analytical aspects of PGC, such as repeatability and reproducibility, are discussed. Applications of the PGC systems are considered for studying reaction rates and product distribution of the thermal degradation of saturated hydrocarbons. M.G.J.

N68-16094*# National Aeronautics and Space Administration, Washington, D. C.
SPECTROPHOTOMETRIC DETERMINATION OF MINUTE QUANTITIES OF IODIDE AND BROMIDE
Tadao Okutani Nov. 1967 10 p refs Transl. into ENGLISH from Nippon Kagaku Zasshi (Tokyo), v. 88, no. 7, 1967 p 737–741
(NASA-TT-F-11379) CFSTI: HC $3.00/MF $0.65 CSCL 07B

Studies were made on the determination of minute quantities of iodide and bromide when iodide, bromide and chloride are present. When a fixed amount of mercury reagent A, ($Hg(NO_3)_2$-KI), and an ethanol solution of diphenylcarbazone are added to the sample solution, iodide ions react with the mercury reagent. The excess mercury reagent reacts with diphenyl-carbazone and forms a purplish-red complex which is soluble in benzene. By measuring the absorbance of the benzene layer at 562 mμ, 0.1≈3.0 ppm iodine can be quantitatively determined, when 100 ppm chlorine and 2 ppm bromine are present. When chloride and iodide ions are present, bromide ions cannot be quantitatively determined with this method, and the following method is used: bromide ions are oxidized to bromine with potassium permanganate, which is extracted with tetrachloromethane. Add mercury reagent B, ($Hg(NO_3)_2$-KI$Hg(SCN)_2$), nitric acid, diphenylcarbazone solution and shake. Bromine is determined by measuring the absorbance of the tetrachloroethane layer at 560 mμ. With this method, 0.1≈2.5 ppm bromine can be accurately determined even when 1000 ppm chloride and 50 ppm iodide ions are present. Author

N68-16097*# Philips Labs., Briarcliff Manor, N. Y.
STUDY PROGRAM TO OBTAIN THE INFRARED INTERNAL REFLECTION SPECTRA OF POWDERED ROCKS Final Report
N. J. Harrick and J. Bloxsom Jun. 1966 69 p refs
(Contract NASw-964)
(NASA-CR-92572; PL-3-IRS66-0603; TR-198) CFSTI: HC $3.00/MF $0.65 CSCL 07D

Previous findings of internal reflection spectroscopic measurements of the infrared spectra of powdered rocks were verified. In the present investigations, pure quartz fractions were used, and the measurements were extended to other angles-of-incidence using polarization and particle size. This is attributed to the birefringent nature of quartz and to the large changes in the optical constants in the vicinity of absorption bands. As a demonstration of the practicality of internal reflection spectroscopy, spectra were recorded of fourteen powdered mineral samples having particle

sizes of 100 microns and less. The spectra were similar to those recorded via transmission using powders of very small particle size (less than 5 μ). Author

07 COMMUNICATIONS

Includes communications equipment and techniques; noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N68-15137# Ohio State Univ., Columbus. ElectroScience Lab.
RADAR CROSS SECTION OF OPEN CIRCULAR LOOPS
Gary A. Thiele 9 Nov. 1967 19 p refs
(Contract AF 19(628)-5167)
(Rept.-2409-3; ESD-TR-67-568; AD-662881)

Two methods of calculating the monostatic and bistatic scattering by an open circular loop are briefly discussed. Theoretical and experimental backscatter results are presented that show how the echo area varies when a straight wire is curved into an arc of decreasing radius of curvature. For small radii of curvature, an interesting resonance phenomena is observed. Author (TAB)

N68-15147# National Scientific Labs., Inc., Washington, D. C.
AUDIO SUBLIMINAL COMMUNICATION Final Report, Jan.-Jun. 1967
John C. Corbin and Robert B. Riedel Griffiss AFB, New York RADC Nov. 1967 121 p refs
(Contract F30602-67-C-0148)
(RADC-TR-67-463; AD-662362)

The results of an in-depth and diversified literature search on the subject of audio subception are reported. The absence of such literature leads to an investigation of the hearing process, together with some theorizing on potential mechanisms for audio subliminality. A test procedure to establish the existence and nature of subliminal processes in the auditory system is proposed. Methods suggested are based on the assumption that subception in this modality is analogous to the visual case, in which some well-documented experiments have demonstrated its existence. Author (TAB)

N68-15186# Radio and Space Research Station, Slough (England).
OPTICAL OBSERVATIONS OF SATELLITES RECEIVED BY THE SATELLITE ORBITS GROUP FOR THE MONTH OF APRIL 1967
1967 37 p

Tabulated data are given for satellite observations received by the Satellite Orbits Group. B.S.D.

N68-15242# Signatron, Inc., Lexington, Mass.
A STUDY OF SPECTRAL ANALYSIS OF SHORT-TIME RECORDS Final Report, Oct. 1966–Sep. 1967
Nicolas Johnson and Richard K. Bennnett 29 Sep. 1967 43 p refs
(Contract N00014-67-C-0184)
(SIG-CR-311; AD-662693)

Several aspects of the problem of spectral estimation based on short-time records have been investigated. These include techniques for estimating the quality of the autocorrelation function based on a finite length of data, new approaches to spectral estimation based on contemporary engineering practices, and the specification of a specially designed computer program to facilitate the analysis of short-time records. The design of the computer program has incorporated the latest techniques of Fourier transform calculations, the so-called Fast Fourier Transform. Author (TAB)

N68-15300# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
PATH INTERMODULATION DISTORTION MEASUREMENTS OF NOISE-POWER-RATIO OVER TROPOSPHERIC BEYOND-THE-HORIZON PATHS EMPLOYING AN FDM-FM SYSTEM
S. Murahata and R. E. Skerjanec Jul. 1967 66 p refs
(ESSA-TR-IER-41-ITSA-41)

A program involving noise-power-ratio measurements was conducted to obtain propagation data for evaluating the path contribution to the intermodulation distortion of an over-the-horizon tropospheric scatter test circuit in the Colorado high plains region. The resulting data are compared with data obtained earlier over another path and with the predictions for both paths. The report describes the equipment and physical arrangement used in the test program and presents the results in some detail. Author

N68-15308# Royal Aircraft Establishment, Farnborough (England).
THE STATISTICAL DISTRIBUTION OF SUMS OF MIXED PAIRS OF PRODUCTS OF PARTLY-CORRELATED GAUSSIAN VARIATES OF ANY VARIANCE
G. F. Clarke Sep. 1967 31 p refs
(RAE-TR-67233) CFSTI: HC $3.00/MF $0.65

A general formula is derived for the resultant probability density function when the products of bivariate Gaussian waves of arbitrary variance and covariance are summed. Author (ESRO)

N68-15322# Eurospace, Paris (France).
RECOMMENDATIONS CONCERNING THE SETTING UP OF A EUROPEAN REGIONAL TELECOMMUNICATION SATELLITE SYSTEM. TECHNICAL AND ECONOMIC STUDIES
Oct. 1967 66 p refs
CFSTI: HC $3.00/MF $0.65

A variety of telecommunication facilities to meet European needs in television distribution, telephony, direct television broadcast, and educational television would be available once a European regional system of satellite telecommunication is established. The possibilities and the value of establishing such a system under consideration of the operational, technical and cost aspects are assessed. A market study was undertaken to evaluate the possibilities and profit potential of eventual European telecommunication satellite system and the results are briefly reviewed. ESRO

N68-15341*# Northrop Space Labs., Huntsville, Ala. Research and Analysis Section.
A METHOD TO DEFINE A MINIMUM-PHASE TRANSFER FUNCTION WITHIN THE BOUNDED REGION OF PHASE-GAIN SPECIFICATIONS
S. Y. Tung and J. W. Fontenot 8 Feb. 1965 87 p refs
(Contract NASB-11111)
(NASA-CR-61459; Memo-55; E20-66) CFSTI: HC $3.00/MF $0.65 CSCL 17B

Presented is a method of defining a minimum-phase transfer function within the bounded regions of phase and gain specifications at several discrete frequencies. The application of complex curve fitting techniques and the principles of gain and phase stability for

a transfer function are employed. The developed method is applied to two conditions and six cases; the results show that the method is simple and effective. Author

N68-15343# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Stratosphaerenphysik.
ON THE DETERMINATION OF VERY LONG WAVE PROPAGATION PARAMETERS FROM GROUND MEASUREMENTS OF FIELD STRENGTH [UEBER DIE BESTIMMUNG VON LANGSTWELLEN-AUSBREITUNG-SPARAMETERN AUS FELDSTAERKE-MESSUNGEN AM ERDBODEN]
J. Frisius 1965 55 p refs In GERMAN; ENGLISH summary
(Rept.-23/1965) CFSTI: HC $3.00/MF $0.65

The propagation of electromagnetic waves with a frequency of 16 kc/sec has been studied in the distance range 350 to 800 km from the transmitter GBR-Rugby. Field strength records carried out continuously at 8 stations during the winter 1962/63 are compared with field strength calculations based upon the 'concept of the equivalent ionosphere'. The possible range of parameters for nighttime and daytime propagation has first been estimated by different comparisons between calculated and measure field strength curves. The sunrise effect has been considered and evidence is found that during about 1.5 hours after sunrise the concept of the equivalent ionosphere does not describe the propagation. Author (ESRO)

N68-15345# Environmental Science Services Administration, Boulder, Colo. Inst. for Telecommunication Sciences and Aeronomy.
TABULATIONS OF VHF PROPAGATION DATA OBTAINED OVER IRREGULAR TERRAIN AT 20, 50, AND 100 MHZ. PART 2: COLORADO MOUNTAIN DATA
M. E. Johnson, M. J. Miles, P. L. McQuate, and A. P. Barsis Aug. 1967 107 p ref
(IER-38-ITSA-38-2; AD-662713)

The report contains tabulations of transmission loss data resulting from propagation experiments at 20, 50, and 100 MHz conducted over irregular terrain in the Colorado Mountains primarily east of the Continental Divide. Author (TAB)

N68-15370*# Terra-Space Corp., Malibu, Calif.
ON THE OPTIMUM REPRESENTATION OF A SIGNAL WITH A LIMITED SPECTRUM TRUNCATED BY THE KOTELNIKOV SERIES
A. Yu. Lav and V. A. Kisel 1967 12 p refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 2, 1967 p 25–32
Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92569) CFSTI: HC $3.00/MF $0.65 CSCL 09D

The moments of gating of signals with a limited spectrum, which assure a maximum speed to convergence of a Kotelnikov series, are selected. A choice is also made of the discrete values of a signal with a limited spectrum. These values are in fact Fourier coefficients of spectral density which satisfy the zero boundary conditions along the phase. Author

N68-15418# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
KINETHEODOLITE OBSERVATIONS MADE AT EARLYBURN. SATELLITE 1965–11 D, APRIL 1965–MARCH 1966
Bennet Mc Innes 22 Nov. 1967 38 p refs
(ROE/STS/65) CFSTI: HC $3.00/MF $0.65

The launch of satellite 1965-11 D took place from the Soviet Union on 21 February 1965 at about 11.00 UT. Cinetheodolite observations were made at Earlyburn on 50 nights during April 1965 to March 1966. The satellite was observed on 16 of these 50 nights: on several nights more than one transit was observed. This report gives fully reduced observations of the 31 transits observed. ESRO

N68-15419# State Univ. of New York, Stony Brook. Coll. of Engineering.
DISPERSION RELATIONS OF PERIODIC AND LOG-PERIODIC DIPOLE ARRAYS WITH PARASITIC ELEMENTS
David F-D. Sun and Richard B. Kieburtz 19 Jun. 1967 35 p refs
(Contract AF 19(628)-4144)
(AFCRL-67-0389; TR-92; SR-3; AD-662638)

Dispersion relations were obtained for uniformly periodic arrays consisting of dipoles driven with glide-symmetric excitation from a uniform transmission line and interspersed with undriven, parasitic dipole elements. The effect obtained by introducing parasitic elements is to reduce the strength of the coupling between the uniform transmission line and the radiating modes of the dipole array at frequencies near the dipole resonances. This type of structure was investigated as a possible prototype for a log-periodic dipole array. The spatial dispersion curve for the L.P. array with parasitic elements was obtained theoretically by the method of coupled mode theory. It appears that the introduction of parasitic elements may enable the length of the active region of such an array to be increased, making possible an increase in directivity. Author (TAB)

N68-15541# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
INFORMATION SCIENCES
In its Tex. Biann. of Electron. Res. 15 Nov. 1967 p 18–90 refs (See N68-15539 06-10)
(Contract NAS8-18120; Grants NGR-44-012-066; N00123-67-C-0383; NSF GK-261)

Research activities relating to the development of mechanized speech recognition are summarized, including data on learning and pattern recognition, nonparametric discriminate functions, adaptive estimation and pattern classification systems, nonlinear control systems, and optimal and suboptimal control procedures. Signal detection, filtering, and parametric information extraction research efforts are reviewed; and repeatability for Gaussian channels, a Gilbert bound for periodic binary convolutional codes, and weakly coupled oscillators were studied. Classification of phonemes by distinctive features is treated, as are construction of irreducible realizations of time-invariant systems and other facets of communication theory. M.W.R.

N68-15554# RAND Corp., Santa Monica, Calif.
DELAY DISTORTION AND SIGNAL IMPAIRMENT IN DIGITAL DATA TRANSMISSION
M. I. Liechenstein Nov. 1967 25 p refs
(P-3723; AD-662337)

Attempts to enhance the transmission rate of digital information through communication channels have imposed increasingly stringent tolerances on the equalization of signal distortion. A primary source of system degradation and signal impairment which has impeded signaling rates is the envelope delay inherent in the data channels. Since the distortion accompanying a nonuniform envelope delay transmission characteristic can limit the imagery acutance of graphical displays, can lead to read-write errors during data storage and retrieval in tape systems, and can cause misinterpretations of digital baseband signals by generating intersymbol dependencies, delay distortion has been a subject of renewed inquiry. Some of the physical and analytical aspects of

envelope delay were examined in order to afford further insight into the nature of delay distortion. Various combinations of signal waveforms and system delay distortion were explored which are encountered in practical situations. Although neither an algorithm for delay equalization was formulated, nor a critique given of the few available techniques of delay equalization, several computational desiderata are outlined, and a deeper understanding of the significance of delay distortion provided. Author (TAB)

N68-15560# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
SYNTHESIS OF PULSE COMPRESSION WAVEFORMS WITH WEIGHTED FINITE FREQUENCY COMBS
David M. White Aug. 1967 101 p refs
(Contract NOw-62-0604-c)
(TG-934; AD-663263)

Frequency weighting in discrete frequency pulse compression radar systems is analyzed and studied experimentally. Pulse compression and matched filter theory from which an analysis of frequency weighting can be developed are presented. The radar ambiguity function, which defines the matched filter range as being equal to the Fourier transform of the input signal spectrum, is derived. This relation is the analytical foundation for the analysis and selection of weighting functions. A practical example of the matched filter theory follows which shows the output waveform to be of the form sin Nx/sin x for uniform frequency weighting. A description of the output reveals the high range sidelobes which can be suppressed by frequency weighting. The DELRA recirculating delay line pulse compressor used to experimentally synthesize the pulse compression outputs for 50 frequency spectra which are amplitude and space weighted is described. Amplitude weighted spectra are used to reduce the range sidelobes, and space weighted spectra are studied mainly for the purpose of thinning the 50 frequency spectra while still providing acceptable pulse compression outputs. Comparisons of the amplitude and space weighting may be made from the results given in photographic and in tabular form which were obtained by using the DELRA. Author (TAB)

N68-15582 Joint Publications Research Service, Washington, D. C.
EXTREMAL PROBLEMS OF INFORMATION THEORY AND DYNAMIC PROGRAMMING
R. L. Stratonovich *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 82–102 refs (See N68-15576 06-10)

A multistep version of two extremal problems in information theory is discussed, in particular, the problem of determining the information value. At the same time the theory of information value is synthesized with the existing optimal control theory based on the concepts and methods of dynamic programming. Author

N68-15597# Navy Underwater Sound Lab., New London, Conn.
THE QUASI-NEAR FIELDS OF DIPOLE ANTENNAS
Peter R. Bannister 13 Oct. 1967 36 p refs Submitted for publication
(USL-857; AD-663277)

The electric- and magnetic-field components produced by vertical and horizontal dipole antennas (both electric and magnetic types) located over, on, or below the surface of a semi-infinite conducting medium are derived and presented for the quasi-near range. (The measurement distance is much greater than an earth skin depth but much smaller than a free-space wavelength.) Previously derived results are briefly summarized. The horizontal separation (rho) between the transmitting and receiving dipole antennas is comparable to their heights. The derivations are the result of applying the quasi-near approximations to the basic Sommerfeld integrals and, in some cases, utilizing the reciprocity theorem. When rho is much greater than the antenna heights, the formulas for the field-component expressions reduce to previously derived results. Some of the field-component expressions are characterized by unusual height gain (or loss) functions, and numerical values are provided for some of these functions. Author (TAB)

N68-15598 National Severe Storms Lab., Norman, Okla.
PRELIMINARY QUANTITATIVE ANALYSIS OF AIRBORNE WEATHER RADAR
Lester P. Merritt Dec. 1967 41 p refs
(RLTM-NSSL-37)

Radar PPI photodata, obtained by an improved version of the RDR-1E airborne X-band radar and the ground based WSR-57 S-band radar, are compared within the framework of applicable radar theory. A simple theoretical model, simulating typical operation conditions, is developed to relate more clearly the expected performance of the airborne radar to that actually obtained in the test program. This model provides a basis for comparison of the ground and airborne radar data. The analysis and data comparison is generally restricted to thunderstorms of only moderate intensity and size (rainfall rates $\leq$25 mm/hr; horizontal dimensions $\leq$8 n mi; vertical development $\leq$40,000 ft), and aircraft altitudes to 40,000 ft. Within these boundaries, however, agreement between the model, the airborne data, and the ground radar data is generally good. Author

N68-15599# Institute for Defense Analyses, Arlington, Va. Science and Technology Div.
AN EXTENSION OF THE KAC-SIEGERT RESULTS AND RELATED TOPICS
Robert D. Turner Nov. 1967 43 p refs
(Contract DAHC15-67-C-0011)
(IDA-HQ-67-6496; P-354; AD-662660)

A tractable expression for the probability distribution of the output of a signal-processing configuration analyzed by Kac and Siegert is derived. The configuration consists of a single-tuned narrow-band input stage, followed by a square-law device, followed by a simple RC integrator. The expression obtained is useful for arbitrary values of the input-output bandwidth ratio. Expressions for the coefficients and parameters of a seven-term Edgeworth series approximation to the probability distribution of a more general configuration are presented for the zero-signal case, and for a two-term approximation when an arbitrary signal is present. The extended Kac-Siegert result is then employed to check the accuracy of the zero-signal Edgeworth approximation for an input-output bandwidth ratio of 50. It is found that the approximation is accurate out to about 4.3 standard deviations beyond the mean, corresponding to a probability of 0.0005 of exceeding the distribution function variable. Author (TAB)

N68-15632# Leeds Univ. (England). Dept. of Electrical and Electronic Engineering.
MICROWAVE SIGNAL PROCESSING DEVICES Final Scientific Report, 1 Jun. 1966–31 May 1967
John O. Scanlan and John D. Rhodes Aug. 1967 253 p refs
(Contract AF 61(052)-925)
(LU/EE/67/12; RADC-TR-67-588; AD-662352)

The analysis and synthesis of microwave devices which support electromagnetic waves in bounded, uniform, passive media were considered. Initially, work is centered upon signal processing devices which support the classical T.E.M. mode of propagation in a lossless medium. Design and synthesis procedures are presented for microwave constant delay and microwave all-pass networks which consist of commensurate elements and their combination leads to the design of the most general form of network in this category. Realisability conditions are presented for networks

consisting of a cascade of non-commensurate transmission lines with lumped two-port networks at the junctions of the lines. This theory relies upon the derivation of a number of theories on multivariable positive real functions. Finally, attention is given to the development of a new theory for microwave devices which support the most general forms of mode propagation in a bounded, uniform, passive medium. The results obtained enable complete propagation characteristics to be determined under steady state sinusoidal excitations with a minimum amount of prior knowledge of the guiding structure. Author (TAB)

N68-15636# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TELEMETRY OF RADIOACTIVE RADIATIONS
A. A. Bragin and V. N. Mikhaylovskiy 12 Jul. 1967 171 p refs Transl. into ENGLISH of the book "Telеizmereniye Radioaktivnykh Izlucheniy" Kiev, Izd. Akad. Nauk Ukr. SSR, 1963 p 1–156
(FTD-MT-65-434; AD-662764)

The book compares contemporary requirements for radiometric instrumentation for geophysical investigations of wells and the possibilities for telemetrical technology in the sense of increasing the accuracy, effectiveness, and the thermostability of instruments; theoretical principles and methods of construction of systems for the transmission of information about radioactive radiations are expounded. Considerable attention is allotted to statistical errors, the analysis of methods, and the calculation of means for increasing accuracy, narrowing the signal spectrum and correcting load characteristics and also for regulating the counters. Author (TAB)

N68-15647# Hughes Aircraft Co., Culver City, Calif. Aerospace Group.
STUDY OF APPLICATION OF ANTENNA OPTIMIZATION TECHNIQUES Final Report, Oct. 1964–Aug. 1967
G. O. Young and A. A. Ksienski 15 Nov. 1967 14 p refs
(Contract AF 19(628)-4358)
(P67-249; AFCRL-67-0632; AD-662341)

The research dealt with decision theoretic antenna processing systems and the development and application of a new coherence theory to optimum antenna system design. The objective was the development of techniques that would result in improved target parameter estimates and better detection and resolution capability than those achieved by conventional systems. A new theory was developed, called transcoherence theory. It can be used to determine the optimum amplitude and/or phase shading for an antenna that is intended as an information-gathering device. It is particularly useful when employed for the purpose of compensating for deleterious medium effects. The theory can also be used to find the coherence properties of sources, where these properties are essential to the specification of the a priori statistics of target signals and clutter. A relatively simple decision theoretic processor was built and found to improve angular resolution by at least a factor of four over that of conventional systems. The research studies and their results are documented in seven scientific reports and several papers. Author (TAB)

N68-15662# Defense Communications Agency, Washington, D. C.
DCS AUTODIN INTERFACE AND CONTROL CRITERIA
Oct. 1967 169 p Supersedes DCA-370-D175-1, 1 Jul. 1965
(DCA-370-D175-1; AD-662073)

The circular specifies procedures to be used for the control of data being interchanged between interconnected elements of the DCS AUTODIN. DCS AUTODIN consists of Automatic Electronic Switching Centers (AESC) used in CONUS and Automatic Digital Message Switching Centers (ADMSC) used overseas. These procedures define the block format for messages and rules for transmission and checking which provide the means of detection and orderly correction of errors. Included is an explanation of a technique in which the parity of control characters differs from that of other digital characters. This parity control system is intended to allow a user connected to the DCS AUTODIN the use of any 7-bit information character without interfering with the communication control functions. The DCS AUTODIN is a digital communications network in which both synchronous and asynchronous operation is employed in the exchange of messages. Synchronous operation is employed on trunks between switching centers and on tributary channels when equipped with appropriate terminal equipment. Asynchronous operation is employed only on tributary channels and interchange channels to other teletypewriter networks. For synchronous operation the system will process traffic at modulation rates of 75 x 2 to the m power baud where m is any positive integer between 1 and 6. Asynchronous channels will accommodate modulation rates of up to 300 baud. Author (TAB)

N68-15697*# Aztec School of Languages, Inc., Acton, Mass.
WIDE BAND QUASI OPTIC PRISM COMPONENTS
T. Sueta, N. Kumagai, and S. Kurazono Washington NASA Jan. 1968 13 p refs Transl. into ENGLISH from J. Inst. Elec. Commun. Engr. Japan (Tokyo), v. 49, no. 3, 1966 p 457–462
(Contract NASw-1692)
(NASA-TT-F-11467) CFSTI: HC $3.00/MF $0.65 CSCL 17H

A quasi-optic directional coupler, attenuator, and magic T which use a dielectric prism matchable over a wide range of bands are proposed. The principle of wide-band matching and the operational characteristics are described. The result of experiments in the 50 Gc band showed an excellent agreement of the experimental and calculated values, confirming that these components have better characteristics than any of this type previously reported. It is believed that the quasi-optic component described in this paper can be applied to a wide range of frequencies from short millimeter and sub-millimeter waves to that of the coherent optical wave region which has recently been developed. Author

N68-15813# Wilcox Electric Co., Inc., Kansas City, Mo.
DEVELOPMENT OF AIRLINE-TYPE PRECISION VOR RECEIVER SYSTEM PVOR(M) Final Report
Robert G. Piper Aug. 1967 51 p
(Contract FA-65-WA-1269)
(RD-67-53)

The objective was to design and produce an engineering model aircraft navigation receiver system to be used for testing the Multilobe Precision VHF Omnirange system, PVOR(M). To assure optimum reliability and stability of the receiver system, the most advanced techniques were employed. The receiver system consists of a modified airline-type VHF navigation receiver and a modified Course Deviation Indicator/Omni Bearing Selector (CDI/OBS) instrument. The modified receiver system permits reception and display of multilobe precision VOR signals as well as the conventional VOR and Localizer signals described in ARINC Characteristic No. 547. Author

N68-15818# Pennsylvania Research Associates, Inc., Philadelphia.
DEMONSTRATION OF DIGITAL RADAR LANDMASS SIMULATION TECHNIQUES Final Technical Report
Orlando, Fla. Naval Training Device Center Oct. 1967 67 p refs
(Contract N61339-1824)
(U67-1043; NAVTRADEVCEN-1824-1; AD-662407)

Technical and economic feasibility of digital radar landmass simulator validated through fully-digital simulation, demonstrating

conformity of simulated airborne radar scope displays to the terrain, hydrography, and culture of corresponding source maps. Methods of data compression verified, and special radar effects protrayed by all-digital simulation. Author (TAB)

N68-15821# Institute for Defense Analyses, Washington, D. C. Science and Technology Div.
DESIRABLE ILLUMINATIONS FOR CIRCULAR APERTURE ARRAYS
Warren D. White Dec. 1967 25 p refs
(Contract DAHC15-67-C-0011)
(P-351; IDA/HQ-67-6476; AD-662658)

The design of phased-array antennas has progressed to the point where side-lobe control is limited by practical problems of aperture efficiency and element tolerances. So far as the theoretical limits are concerned it is possible to provide a variety of designs meeting any side-lobe specification desired. This being the case, it becomes desirable to examine the requirements for low side lobes more critically. In particular, it is felt that more attention should be given to desirable relations between the average side-lobe level and peak side-lobe level. To provide some insight into the type of pattern control that is possible, numerical calculations have been made for a variety of illuminations having the same aperture efficiency. It is shown that by allowing the peak side lobe to increase slightly, important improvements can be made in the level of the more remote side lobes. Author (TAB)

N68-15823*# General Dynamics/Convair, Huntsville, Ala.
AUTOMATIC MALFUNCTION ANALYSIS BY DISCRETE NETWORK SIMULATION Final Report, Supplement
May 1967 10 p
(Contract NAS8-20016)
(NASA-CR-61460; GDC-DDF66-007) CSCL 09F

Possible improvements are suggested in the logic model building techniques used to develop the discrete network simulation method of providing supplemental information for the checkout of the Saturn 5. The items recommended for further study include (1) a short cut coding technique to minimize the repetitive writing required to identify each variable in the model; (2) a revised time card format which would include only two time fields left adjusted to the variable name field; (3) the feasibility of eliminating the time card; (4) use of a sorting program based on a coded condensed format; (5) changes in the printout format of the preprocessor–editor program; and (6) a program for storing the complete model on tape, with provision for making corrections on the tape. M.G.J.

N68-15834*# Princeton Univ., N. J. School of Engineering and Applied Science.
THE EFFECT OF CHANNEL ERRORS ON DATA COMPRESSION
Lee D. Davisson [1967] 5 p refs
(Grant NGR-31-001-068)
(NASA-CR-92513) CFSTI: HC $3.00/MF $0.65 CSCL 09D

Consideration is given to the effects of channel noise on received reconstructed data which is compressed prior to transmission. The energy compression ratio is defined and used as a figure of merit for a given system. Calculations are illustrated for run length coding with periodic synchronization. Noise is shown to have a critical effect on system performance. In fact, if the signal-to-noise ratio is too low, run length coding is found to be worse than no data compression at all from a data quality point of view. Properly employed, an improvement can be gained by using error correcting codes. Author

N68-15837# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
THE FIRST DECADE OF SATELLITE TRACKING AT THE OBSERVATORY
Bennet McInnes 9 Oct. 1967 6 p refs
(ROE/STS/64) CFSTI: HC $3.00/MF $0.65

The first optical observation received in the Soviet Union from another country was made at Edinburgh Observatory: Sputnik 1 rocket was seen on 9 Oct. 1969 at 05h 30 min., and an observation was recorded (to the nearest second in time and the nearest degree in azimuth and elevation). This report reviews the first decade of satellite tracking at the Observatory. The number of successful launches of earth satellites and space probes in each calendar month for these ten years is given; it is shown that launches are now occurring at a rate of about one every third day. Almost all of these launches give rise to several orbiting objects. Reference is made to the Philosophical Transactions of the Royal Society which review some of the achievements and some of the future goals of satellite tracking. ESRO

N68-15894# Massachusetts Inst. of Technology, Cambridge Research Lab. of Electronics.
RESEARCH LABORATORY OF ELECTRONICS Quarterly Progress Report, Period Ending 30 Nov. 1968
George G. Harvey and H. J. Zimmermann 15 Jan. 1967 390 p refs
(Contract AT(30-1)-3581)
(QPR-84; TID-23760) CFSTI: HC $3.00/MF $0.65

The objectives of each research group are defined, and summary data are presented on the experimental activities being conducted and the results which have been obtained. In the area of general physics the studies relate to molecular beams and collisions; microwave, optical, and infrared spectroscopy; atomic resonance and scattering; electron magnetic resonance; ultrasonic properties of solids; gravitation; physical electronics and surface physics, physical acoustics, and electrodynamics of media. Plasma dynamics and physics projects center on plasmas and controlled nuclear fusion, and interaction of laser radiation with plasmas and nonadiabatic motion of particles in magnetic fields. Communication sciences and engineering are also considered, with brief reports presented on such studies as statistical communication theory, information processing and transmission; cognitive information processing, neurophysiology, and computer and computation research. M.G.J.

N68-15976 Joint Publications Research Service, Washington, D. C.
RECENT TECHNICAL DEVELOPMENTS IN SATELLITE COMMUNICATIONS SYSTEMS
16 Jan. 1968 38 p refs Transl. into ENGLISH from Russian
(JPRS-44023)

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N68-15977 Joint Publications Research Service, Washington, D. C.
PASSIVE RELAYING FOR RADIO COMMUNICATIONS RELAY LINES

G. Z. Ayzenberg and V. G. Yampol'skiy *In its* Recent Tech. Develop. in Satellite Commun. Systems 16 Jan. 1968 p 1–15 refs Transl. into ENGLISH from Radiotekhn. (Moscow), no. 11, Nov. 1967 p 44–55 (See N68-15976 06-07)

A radio relay system with passive relaying and a double distance between the active points was investigated; and it is noted that the stability of communication is determined by the reliability of the equipment and power supply sets in the points of the lines as well as by the fading conditions in the line spans. Stability and reliability of such communication networks are considered sufficiently high; and the use of passive relaying to increase the distance between active points reduces construction costs and simplifies system operation. Simplification of operation and increasing line carrying capacity can also be accomplished by using low bearings for the active points and by shortening length of waveguides. The passive relaying discussed is considered most effective and economical for broken terrain conditions, and the use of obstacle type of relaying often does away with the use of high support poles. M.W.R.

N68-15978 Joint Publications Research Service, Washington, D. C.

ORBIT GROUND STATION FOR RECEPTION OF TV PROGRAMS FOR AES

N. V. Talyzin, L. Ya. Kantor and M. Z. Tseytlin *In its* Recent Tech. Develop. in Satellite Commun. Systems 16 Jan. 1968 p 16–22 Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 11, Nov. 1967 p 4–8 (See N68-15976 06-07)

Ground relay stations, called orbit stations, are being designed to permit reception of television in remote regions via the use of artificial earth communications satellite. The orbit station, which can transmit signals for distances of more than 10,000 km, is described; and details of the low-noise input amplifier are included. A synchronous detector increases the noiseproof features of the receiver; and elimination of interference from radio relay stations is considered. The importance of selecting a good location for such an orbit station is stressed. M.W.R.

N68-15979 Joint Publications Research Service, Washington, D. C.

ON USING THE SSB–FM COMBINATION IN SATELLITE COMMUNICATIONS SYSTEMS

V. L. Bykov and S. M. Khomutov *In its* Recent Tech. Develop. in Satellite Commun. Systems 16 Jan. 1968 p 23–32 refs Transl. into ENGLISH from Elektrosvyaz (Moscow), no. 11, Nov. 1967 p 9–16 (See N68-15976 06-07)

Operations of both a simple transformer and a differential transformer are analyzed in connection with applications for communication satellite systems. The nonlinearity of the transformation characteristics is considered a disadvantage to both types of transformers, and feedback is then discussed as a means of improving transformer characteristics. While the complexity and number of units of the transformer with feedback is about the same as that for a differential transformer, the feedback offers some qualitative advantages. M.W.R.

N68-16000# Battelle Memorial Inst., Columbus, Ohio.

SCATTERING FROM SURFACES WITH DIFFERENT ROUGHNESS SCALES: ANALYSIS AND INTERPRETATION

Donald E. Barrick and William H. Peake 1 Nov. 1967 63 p refs

(Contract DA-49-083-OSA-3176; ARPA Order 197)

(BAT-197A-10-3; AD-662751)

The report discusses several approaches to scattering from slightly rough, very rough, composite, and rough spherical surfaces. Average incoherent scattering cross sections for slightly rough surfaces are obtained using a perturbation technique for a perfect conductor and for a surface material which is homogeneous. Three optics techniques are presented which yield scattering cross sections for very rough surfaces, and it is shown that all give the same solution for Gaussian surfaces. Composite surfaces, i.e. ones consisting of both slightly rough and very rough structures together, are analyzed, and a heuristic physical derivation of their scattering cross section is presented. Average backscattering cross sections for rough spherical surfaces also are presented. Both the coherent and incoherent cross sections are given for slightly rough and very rough spheres. Physical interpretation of the scattering mechanism is emphasized. Author (TAB)

N68-16013 Joint Publications Research Service, Washington, D. C.

DEVELOPMENT OF SHIP ANTENNA EQUIPMENT

N. I. Pavlov, E. A. Glushkovskiy and T. A. Gurgenidze *In its* Recent Develop. in Shipboard Electron. Equipment 16 Jan. 1968 p 1–5 (See N68-16012 06-09)

Antenna installations and communication equipment for shipboard applications are discussed in general terms; and antennas with inductive–capacitive loads are illustrated and considered. Diagrams are also included for stub, mast, and corner antennas; and it is concluded that superwide antennas, principally impedance and loop types with active or reactive connections, will be used in the future. M.W.R.

N68-16014 Joint Publications Research Service, Washington, D. C.

THE "OKEAN" MARINE RADAR SET

I. P. Lisenenkov and B. F. Volynets *In its* Recent Develop. in Shipboard Electron. Equipment 16 Jan. 1968 p 6–14 (See N68-16012 06-09)

Reliability of the Okean marine radar set, which has two frequency ranges, is discussed; and technical characteristics of the set for use aboard high tonnage freight or passenger ships are tabulated. Production has begun for the set, which has both computing and self-describing devices. Okean offers an increase in effective radius capability under adverse weather conditions, and also increases safety on the seas because it can operate on two channels. M.W.R.

N68-16048*# Codex Corp., Watertown, Mass.

CODING SYSTEM DESIGN FOR ADVANCED SOLAR MISSIONS Interim Report

20 Oct. 1966 51 p

(Contract NAS2-3637)

(NASA-CR-73174) CFSTI: HC$3.00/MF$0.65 CSCL 09F

Extensive computer simulations of different coding schemes were used for orthogonal equation decoding of both convolutional and block codes on a white gaussian channel. A simulated sequential decoder was programmed in Fortran and used for extensive simulations. Also written was a short computational program to evaluate different equal-step quantization schemes. All simulations established the performance superiority of sequential decoding over the orthogonal equation decoding schemes. Machine language sequential decoders were designed and written for the 910-920 and for the 7094. G.G.

N68-16055# Air Force Cambridge Research Labs., Bedford, Mass. Microwave Physics Lab.

THE ELECTROMAGNETIC SCATTERING OF BROAD BANDWIDTH RANDOM SIGNALS BY A DISCRETE TARGET

John K. Schindler Nov. 1967 43 p refs *Its* Phys. Sci. Res. Papers no. 345

(AFCRL-67-0602; AD-662874)

Recent papers have emphasized the linear systems aspect of the electromagnetic scattering from a stationary, discrete target. They show that the temporal response of the far-zone scattered field is the convolution of the temporal impulse response of the scatterer with the waveform of the illuminating plane wave. In this paper the scattering system response to an illuminating waveform which is a broadband, temporally stationary random process is discussed. As expected from the classical theory of the noise response of linear systems, the crosscorrelation properties of arbitrary components of the scattered field at two space-time points can be determined from the temporal autocorrelation function of the illuminating waveform and the appropriate target impulse responses. A consideration of the power spectral density of the bistatic scattered field at a large range r from the target leads to an alternate interpretation of the target scattering cross section. It may be thought of as 4 pi r square times the power spectral density of the bistatic scattered field when the target illumination is white noise. By analogy with the classical definition of the bistatic scattering cross section for monochromatic excitation, one can define the effective scattering cross section of a target for broadband illumination. The effective cross section is proportional to the integral over all frequencies of the classical cross section weighted by the power spectral density of the illumination. The effective bistatic cross sections of various targets in the Rayleigh and optics regions are exhibited and compared with the classical bistatic cross sections. Author (TAB)

08 COMPUTERS

Includes computer operation and programming; and data processing. For basic research see: 19 Mathematics.

N68-15089# Radio Corp. of America, Princeton, N. J. RCA Labs.
FORMAL DEFINITION OF CDL1, A COMPUTER DESCRIPTION LANGUAGE
Chitoor V. Srinivasan Oct. 1967 106 p
(Contract AF 19(628)-789)
(SR-2; AFCRL-67-0588; AD-662899)

This is a companion report to Scientific Report No. 1, An Introduction to CDL1, a Computer Description Language (AD 661 591). This gives a formal definition of CDL1. The two reports together provide a complete documentation for the language. TAB

N68-15096# Lincoln Lab., Mass. Inst. of Tech., Lexington.
INCREMENTAL SIMULATION ON A TIME SHARED COMPUTER
Malcolm Murray Jones (Ph.D. Thesis) Jan. 1968 253 p refs
(Contract Nonr-4102(01); Proj. Mac)
(MAC-TR-48; AD-662225)

The thesis describes a system which allows simulation models to be built and tested incrementally. It is called OPS-4 and is specifically designed to operate in the environment of the Multics system. It represents a major expansion and improvement of the OPS-3 system implemented in CTSS and also includes many features adapted from other current simulation systems. The PL/1 language, augmented by many additional statements and new data objects, provides the basis for defining models in OPS-4. A list of desirable features for an incremental simulation system is presented and it is shown how OPS-4 incorporates these features, whereas other current simulation systems satisfy only some of them and are not suitable for use in time-shared environment. A simplified model of page and segment fault handling in Multics illustrates some of the features OPS-4 provides to allow the user to continuously interact with a model during its construction, testing and running phases. It also illustrates how the user himself may portray portions of a model that are not yet defined. Author (TAB)

N68-15128# RAND Corp., Santa Monica, Calif.
DIGITAL COMPUTER SIMULATION: THE ALLOCATION OF COMPUTER TIME IN COMPARING SIMULATION EXPERIMENTS
G. S. Fishman Oct. 1967 31 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5288-1-PR; AD-662592)

The report describes an improved step-by-step procedure for minimizing the computer time needed to obtain a specified statistical precision in the comparison of simulation experiments. The simulations are considered as covariance stationary stochastic processes. Well-known time-saving methods for reducing variance by inducing positive correlations between the experiments and high negative correlations between replications are included in the procedure. Results show that for a given level of accuracy, significantly less computer time is required when sample sizes are determined by the method suggested in this study than when they are equal. Also, small differences in the autocorrelation functions are important when each process is highly correlated. TAB

N68-15153# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
THE DATA LINK CONTROLLER FOR THE FAST (880K BIT/SEC) A.E.R.E. DATA LINKS
J. S. Austin Oct. 1967 20 p refs
(AERE-R-5598) HMSO: 3s

A description is given of the details of the Controller of the Fast (880k bit/sec) Data Transmission Links between computers at A.E.R.E. The main functions of the equipment are parallel/serial and serial/parallel conversion, buffering between computer and transmission system, and interfacing with the computers being used. Author

N68-15161# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE QUANTITATIVE EVALUATION OF THE TERMINOLOGY OF A VOCABULARY [O KOLICHESTVENNOY OTSENKE TERMINOLOGICHNOSTI LEKSIKI]
L. G. Kravets 13 Jun. 1967 19 p refs Transl. into ENGLISH from Nauchn.-Tekhn. inform. (USSR), no. 2, 1965 p 27-29
(FTD-HT-66-515; AD-662574)

A quantitative method for selecting key words to be used in information retrieval language is described. The method is closely associated with the traditional problem of singling out terms. A term is defined as a unit in a vocabulary system used to express a system of concepts in a given branch of science. The process by which words become terms can be broken into two stages: entrance of the vocabulary unit into the sphere of limited function, and maintenance or acquisition by a certain part of the vocabulary of certain characteristics which distinguish the vocabulary of terms from the general vocabulary. There are various degrees in the process by which words become terms, and these degrees can be quantitatively analyzed. Four groups of terms may be distinguished, depending on the place which the terminological meaning occupies in the semantic structure of the word: (1) words all of whose meanings pertain exclusively to a given branch of science; (2) words whose primary meanings pertain to a given terminology; (3) words whose primary meanings do not pertain to a given terminology; and (4) words which are used in texts on a particular subject in

one or several of their general meanings, which are to some extent specialized through combination with words that are terms, e.g., accident in nuclear accident and start-up accident. Author (TAB)

N68-15164# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COMPUTERS WITH CORE-DIODE ELEMENTS [VYCHISLITEL'NYYE USTROYSTVA NA FERRIT-DIODNYKH ELEMENTAKH]
Yu. A. Makhmudov 27 Jun. 1967 15 p Transl. into ENGLISH from Izv. Akad. Nauk Azerb. SSR, Ser. Fiz.-Mat. i Tekhn Nauk (Baku), no. 6, 1964 p 27–35
(FTD-HT-67-48; AD-662793)

The author describes a digital computer developed at the Computation Center of the Azerbaydzhan Academy of Sciences, using sequential and in some cases parallel-sequential units. The computer employs commercially produced ferrite-diode elements, operating at a low timing frequency (30 kcs). The article describes the principles underlying individual units of the computer, which can be used either independently or as parts of other computer systems. All the computer units operate with 24-digit binary numbers (including the sign digit) with fixed radix. The units described are a universal arithmetic unit of sequential action, the information input unit, the external magnetic-tape memory, and the output unit. The computer employs a total of 88 simple and 50 logic elements. TAB

N68-15177# Royal Aircraft Establishment, Farnborough (England).
TWO COMPUTER PROGRAMMES FOR THE AUTOMATIC PLOTTING OF ROOT LOCUS DIAGRAMS
J. M. Freeland and B. E. Taylor Sep. 1967 21 p refs
(RAE-TR-67247; AD-663366) CFSTI: HC $3.00/MF $0.65

The report explains how to use the mercury autocode programmes 320 and 321 to draw root locus diagrams on the Benson-Lehner incremental plotter. Author (TAB)

N68-15195# Informatics, Inc., Bethesda, Md.
A STUDY OF THE REMOTE USE OF COMPUTERS Final Report, Jul. 1, 1966–Jan. 31, 1967
George O. Collins, Jr. 31 Jan. 1967 108 p
(Contract CST-313)
(TR-67-679-1; PB-175666)

The study of the remote use of computers described in this report was divided into three phases. In Phase 1, a survey was made of more than 200 computer installations which were using the central processor capability through remote terminals. Techniques of the survey are described and the response data are summarized. In Phase 2, four computer systems selected from those surveyed were studied in depth. Detailed case studied on these systems were prepared. The final phase was devoted to analysis of data and information collected on remote computer systems with greater emphasis being given to time-shared systems. A picture of the current state of the art is presented with recommendations for areas where further work needs to be done and areas where standardization is needed or desirable. Author

N68-15206# General Motors Corp., Kokomo, Ind. Delco Radio Div.
MICROCIRCUIT COMPUTERS FOR FIRE AND OVERHEAT DETECTION IN MANNED FLIGHT VEHICLES Technical Report, Feb. 1–Sep. 1, 1967
B. J. Raskauskas and E. G. Whitaker Wright-Patterson AFB, Ohio AF Aero Propulsion Lab. Dec. 1967 42 p
(Contract F33615-67-C-1343)
(AFAPL-TR-67-145; AD-663247)

The object of the program was to design and build a microcircuit computer to be used for a fire and overheat detection system for manned flight vehicles. This computer integrates four each infra-red, ultra-violet and continuous element detectors into a single system. Five modes of operation; Normal, Emergency, Fire 1, Fire 2, and Overheat are available by switching. The final computer which uses specially designed and constructed flatpack modulates has a total volume of 3.6 cubic inches and weighs less than five ounces. Operational temperature capability ranges from -55C to +125C. The computer is designed to drive an Alpha-Numeric type readout with four separate notations, FIRE, OVERHEAT, FAIL and OK. Computer design guidelines and philosophy leading up to the final design and fabrication of this computer are reported in AD-663 213. Author (TAB)

N68-15211# Bolkow Entwicklungen K. G., Munich (West Germany).
THE THIRD STAGE CHECK-OUT SYSTEM. ELDO-A PROGRAM [DAS CHECKOUT-SYSTEM DER 3.STUFE. ELDO-A PROGRAMM]
Horst Senger 16 Sep. 1966 14 p In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Germany, Oct. 1966
(DGRR/WGLR Paper-66-066; Bolkow-EV-61-O) CFSTI: HC $3.00/MF $0.65

The role of the third stage check-out system is to ensure, and demonstrate, the flight-readiness status of the third stage, to check its continuing readiness up to rocket lift-off, and in the final phase before lift-off, direct the transition from readiness status to climb phase status. The present report describes briefly the components of the check-out system and their essential functions and operating principles. The basic characteristics are illustrated by means of four block diagrams, while five photographs give an idea of the hardware in actual use. ESRO

N68-15244# Illinois Univ., Urbana. Dept. of Computer Science.
A STUDY OF TRANSFORMATIONS APPLICABLE TO THE DEVELOPMENT OF LIMITED CARRY-BORROW PROPAGATION ADDERS
Fred A. Rohatsch (Ph.D. Thesis) 1 Jun. 1967 114 p refs
(Grant NSF GP-4636)
(Rept.-226)

The dissertation presents the results of a study of a class of transformations applicable to the operations of addition and subtraction in parallel digital computers utilizing redundant number representations in the arithmetic unit. The dissertation is organized into three main sections presented in sequence. The first section includes the definition, development, and study of a class of transformations on sets of real numbers. The second section is concerned with the application of the transformations to addition and subtraction. The primary function of the second section is the development, by an example, of a systematic procedure for finding some limited carry/borrow propagation adders subject to specified operand and sum/difference digit sets. The same procedure is applicable whatever the number of input operands may be. The third section presents the results of a study of some statistical properties of a few selected adders; the purpose of the study being to determine probabilistic distributions of sum digits given the distributions of operand digits, and to examine the effect of repeated uses of an adder on such distributions. Author

N68-15251 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW. AVIATION INSTITUTE
2 Jun. 1967 173 p refs Transl. into ENGLISH from Tr. Mosk. Aviats. Tekhnol. Inst. (Moscow), v. 149, 1962 p 1–188
(FTD-MT-64-69; AD-662467)

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3. INVESTIGATION OF FLIP-FLOPS AND REGISTERS FOR AMPLITUDE SYSTEMS OF INTERMITTENT AUTOMATION M. S. Neyman, L. I. Telyatnikov, and G. P. Zemtsov p 29–40 refs (See N68-15254 06-08)

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7. TRIGGER PHENOMENA IN CIRCUIT WITH NONLINEAR CAPACITANCE OF p–n JUNCTION IN PRESENCE OF d-c FEEDBACK V. I. Samoylenko and I. A. Glotov p 77–92 refs (See N68-15258 06-10)

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12. CONCERNING THE AUTOMATION OF PROGRAMMING HIGH-SPEED DIGITAL ELECTRONIC COMPUTER SYSTEMS M. S. Neyman p 153–168 (See N68-15263 06-08)

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N68-15252 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SUPERHIGH FREQUENCY CALCULATING INTERMITTENT AUTOMATION [O SVERKHVYSOKOCHASTOTNOY VYCHISLITEL'NOY PRERYVNOY AVTOMATIKI]

M. S. Neyman *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 7–14 (See N68-15251 06-08)

This article deals with problems or ways of further increasing the high-speed operation of electronic machines. Methods of creation of superfast-acting electronic machines are discussed. The article also discusses superhigh frequency flip flops and their application.

Author

N68-15253 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT THE BASIS OF CONSTRUCTION OF SYSTEMS OF SUPERHIGH FREQUENCY INTERMITTENT AUTOMATION [OB OSNOVAKH POSTROYENIYA SISTEM SVERKHVYSOKOCHASTOTNOY PRERYVNOY AVTOMATIKI]

M. S. Neyman *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 15–25 refs (See N68-15251 06-08)

In this work there are considered certain fundamental questions of construction of amplitude, frequency, phase, and mixed systems of superhigh frequency intermittent automation as well as certain general questions of construction and use of superfast-acting systems of such type. Elements of circuits of superhigh frequency systems for information processing are discussed along with examples of methods of realization of logic operations with the aid of superhigh frequency flip-flops. Mixed systems of superhigh frequency automation and input and output information of superfast-acting devices of intermittent automation are also described.

Author

N68-15254 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF FLIP-FLOPS AND REGISTERS FOR AMPLITUDE SYSTEMS OF INTERMITTENT AUTOMATION [ISSLEDOVANIYE TRIGGEROV I REGISTROV DLYA AMPLITUDNOY SISTEMY PRERYVNOY AVTOMATIKI]

M. S. Neyman, L. I. Telyatnikov, and G. P. Zemtsov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 29–40 refs (See N68-15251 06-08)

In this work there are expounded results of experimental investigations of main elements of amplitude systems of intermittent automation—amplitude flip flops and registers. For greater clarity and simplicity of these first investigations they were conducted at a comparatively low frequency of natural oscillations and on vacuum electron tubes but not on semiconductor instruments. Results of experiments confirmed the possibility of construction of and also the obtaining of reliable operation of amplitude binary flip-flops and registers based on the use of self-excited oscillators possessing rigid conditions of self-excitation. For experiments there was selected a frequency of cyclic modulation significantly lower than the frequency of self-excitation of flip-flops. Therefore rise and fall times of natural oscillations were small as compared with the period of modulation. A separate problem is the selection of the optimum values of feed-back, Q-factors of circuits, and other parameters for determination of conditions for obtaining of the greatest possible ratio of modulating frequency to the frequency of self-excitation and also the manifestation of peculiarities of operation during very large values of both these frequencies.

Author

N68-15255 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY OF HIGH-SPEED OPERATION OF AMPLITUDE FLIP-FLOPS [TEORIYA BYSTRODEYSTVIYA AMPLITUDNYKH TRIGGEROV]

L. I. Telyatnikov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 41–53 (See N68-15251 06-08)

In the present article the process of build-up of oscillations in the self-excited oscillator with rigid conditions was investigated for the purpose of determination of conditions under which the time of increase of the starting amplitude by required number of times will be least. Here it was assumed that the filling frequency of the starting radiopulse coincides with frequency of the natural oscillations of flip-flop. Calculations show that for the considered example the cyclic frequency can be 20–30 times lower than the basic frequency of flip-flop. This means, for example that for a natural frequency of the flip-flop of 10,000 kilocycles the cyclic frequency can be equal to 300–500 Mc. Increase of speed of operation of the amplitude radiopulse flip-flops can be obtained through increase of the basic frequency of flip-flops or through increase of the coefficient of speed of operation on a selected frequency. In the last case the main effect can be achieved through use of instruments with high transconductance.

Author

N68-15256 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF LOGIC ELEMENTS FOR THE AMPLITUDE SYSTEM OF INTERMITTENT AUTOMATION [ISSLEDOVANIYE LOGICHESKIKH ELEMENTOV DLYA AMPLITUDNOY SISTEMY PRERYVNOY AVTOMATIKI]

M. S. Neyman and G. P. Zemtsov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 55–66 (See N68-15251 06-08)

In the present work is considered construction of logic elements for a similar system with the use of mutual frequency synchronization of input flip-flops. The investigation bears a preliminary character and is executed, as far as it is known to the authors, for the first time. As in the preceding case, for greater simplicity and clarity of initial experiments they were conducted on vacuum-tube triodes and at a comparatively low frequency of natural oscillations. The experimental investigation of logic elements for the system of intermittent automation with binary amplitude recording of information showed that with the use of the phenomena of mutual synchronization of input oscillators is possible to fulfill all four operations, AND, OR, EXCLUSIVE OR, and NOT. Reliable operation of logic elements executing these operations was observed. Additionally it was established that it is possible to execute external "synaptic" control for the transition from one operation to another in the same element. The transition from AND operation to OR operation and conversely can be carried out by a simple change of bias voltage at the grid of the output flip–flop, while transition from EXCLUSIVE OR operation to NOT operation and conversely requires change of the operating conditions of one of the input flip-flops. For the transition from one pair of operations to another pair it is necessary to switch from resistive to capacitive coupling. Author

N68-15257 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PARAMETRIC OSCILLATOR WITH TWO STABLE STATES OF FREQUENCY [PARAMETRICHESKIY GENERATOR S DVUMYA USTOYCHIVYMI SOSTOYANIYAMI CHASTOTY]

V. I. Samoylenko and B. S. Finogenov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 69–76 (See N68-15251 06-08)

The development of contemporary calculating technology requires an increase of speed of operation and an increase of reliability. One of the most effective methods of increase of speed of operation, which in the last years has been quite intensely investigated, is the application of high frequency binary elements, in which information is transmitted as discrete values of amplitude, frequency, or phase of high frequency sinusoidal oscillations. A significant increase of the reliability of the binary elements can be obtained by excluding from them the active quadripole, vacuum tube or transistor, which is the main source of unreliability of equipment. One of the possible variants of the high frequency binary element of increased reliability is the parametric oscillator with two (or several) stable states of frequency. Multiloop parametric oscillators with fixation (memorization) of frequency can be applied not only in digital computers but also in various others. In all probability, with proper modification of the circuit the quantity of memorized frequencies can be increased to 6–10 and even more. This will make it possible to apply the offered circuits for an analysis of the spectrum of instantaneous oscillations, etc. Author

N68-15262 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PRINCIPLES OF CONSTRUCTION OF MEMORY AND CODE-SELECTION ELEMENTS FOR SYSTEMS OF HIGH-FREQUENCY INTERMITTENT AUTOMATION [O PRINTSIPAKH POSTROYENIYA ELEMENTOV PAMYATI I KODOVOY SELEKTSII DLYA SISTEM VYSOKOCHASTOTNOY PRERYVNOY AVTOMATIKI]

M. S. Neyman *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 143–152 refs (See N68-15251 06-08)

In the present article are considered certain methods which make it possible to build memory components for systems of intermittent automation using oscillation of radio frequencies with amplitude, frequency, phase, and mixed recording of information, and also code-selection devices. In view of the high degree of high-speed operation which are inherent to such systems, not only questions relative to long-term memory but also questions relative to a type of memory capable of storing information only over very short intervals of time acquire importance. Author

N68-15263 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE AUTOMATION OF PROGRAMMING HIGH-SPEED DIGITAL ELECTRONIC COMPUTER SYSTEMS [OB AVTOMATIZATSII PROGRAMMIROVANIYA SVERKHBYSTRODEYSTVUYUSHCHIKH VYCHISLITEL'NYKH SISTEM DISKRETNOY ELEKTRONNOY AVTOMATIKI]

M. S. Neyman *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 153–168 (See N68-15251 06-08)

The question of automating algebraic conversions in discrete systems of automation is examined. The following 7 types of elements of algebraic automation are proposed: the number, the first order function (addition, subtraction), the second order function (multiplication, division), the third order function (involution, taking the root of), the inverse order of the functions, and the equality. The number as the most frequent element forms the base, and the consistency as the most general forms the vertex of a pyramid. The other elements: equalities, first, second and third order functions are arranged between these. This system makes it possible to easily depict graphically any algebraic expression using conditional symbols and arranging them according to the established hierarchy from six levels. The relationship between the elements is represented by lines with arrows. The problem of algebraic conversions are examined for which the same algebraic expressions are discrete since they are a series of discrete steps. Conversions are successfully carried out by basic switching of relationships among elements. Author

N68-15264 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

CONCERNING THE ELECTRONIC AUTOMATION OF RESEARCH WORKS [OB ELEKTRONNOY AVTOMATIZATSII ISSLEDOVATEL'SKIKH RABOT]

M. S. Neyman *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 169–182 (See N68-15251 06-08)

The nature of research or creative work consists of the formulation and solution of the corresponding problems; it is not known beforehand with authenticity whether they have a definite and positive answer, and similarly we cannot show beforehand the simple algorithm which with exact and sequential carrying out of the operations specified by it will inevitably lead to the solution of a given problem. Solution of the problem becomes routine if only the number of the necessary operations lies within the limits of practical possibility and expediency. Since the use of high-speed and, especially, of superhigh-speed, electronic calculating and logic machines sharply increases the limits of the practical possibility of fulfillment of very long sequences of operations of a comparatively broad class, then this expands substantially the region of easy solution of routine problems, and also simplifies and accelerates their solution. Let us turn our attention to the use of digital automation systems for the solution of not only routine but also of research problems. In otherwords we shall assume that the problem cannot be completely programmed, i.e., a full set of initial data necessary for that does not exist. We shall demonstrate that even for problems of such type algorithms in a broad sense can be shown. Author

N68-15298# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A LOW LEVEL ANALOG DIGITAL CONVERTER

Chi-tien Sah, Hsi-en Li, Teh-mow Chu, and Tsu-ming Lu 21 Aug. 1967 17 p ref Transl. into ENGLISH from Tzu Tung Hua Hsueh Pao, v. 2, no. 2, 1964 p 90–96 (FTD-HT-67-44; AD-662891)

An analog-digital converter using the comparison method is recommended. This converter is especially suitable for low-level input signals and is fully transistorized. The construction and characteristics of the main functional devices are briefly discussed. Technical specifications and design considerations are also given. Author (TAB)

N68-15332# Vitro Corp. of America, Eglin AFB, Fla. Services Div.
LOGIC, LOGICAL DESIGN AND DIGITAL CIRCUITS
H. K. Scherer Eglin AFB, Fla. Air Proving Ground Center Dec. 1967 103 p
(Contract F08635-68-C-0001)
(APGC-TR-67-141; AD-662878)

The material begins with a discussion of logical propositions and their mathematical extension - Boolean algebra. This is followed by various representations of Boolean functions including the graphical method. The concept of designation numbers as a unique circuit description is developed followed by simplification methods and reduction by maps. Application of these methods to actual circuit design is demonstrated by various examples. In the final portion the more common digital building blocks are presented and discussed. Author (TAB)

N68-15337# RAND Corp., Santa Monica, Calif.
SOVIET CYBERNETICS: RECENT NEWS ITEMS NUMBER 10
Wade B. Holland, ed. Nov. 1967 82 p
(P-3600/10; AD-662333)

Contents: Readership survey; Brief items; Logical design of VNIIEM-3 control computer; Promin-M and UM-1 orders being taken; Importance of heuristic programming; Pattern recognition laboratory at Novosibirsk; Glushkov survey of management systems; Tbilisi-1 control computer announced; Management system at Barnaul radio plant; Automation of planning; work of Ukrainian GOSPLAN; Press review, October 1967. TAB

N68-15347*# Ampex Corp., Redwood City, Calif.
A COMPUTER SIMULATION OF DIGITAL RECORDING Final Development Progress Report, 29 Dec. 1966–29 Dec. 1967
J. Mallinson, C. Steele, L. Lienhard 29 Dec. 1967 141 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951785)
(NASA-CR-92576; RR-67-36) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Results obtained with the use of a digital computer simulation of a tape recording process, the tape demagnetization–remagnetization cycle, the readout process, and several detector processes, are presented. The JPL-4 (Fourier series type) and JPL-6 programs are described. All phenomena up to and including the reproduce head output for the pure tape recorder, and problems associated with detection, drop-outs, white Gaussian noise, and other signal processing operations are discussed. L.S.

N68-15372# Lincoln Lab., Mass. Inst. of Tech., Lexington.
A LOW COST OUTPUT TERMINAL FOR TIME SHARED COMPUTERS
Ronald C. Rosenberg, Daniel W. Kennedy, and Roger A. Humphrey Mar. 1967 31 p refs
(Contract Nonr-4102(01); Proj. Mac)
(MAC-TR-38; AD-662027)

A low cost remote terminal which provides output in switch form from a time-shared digital computer is described. The terminal consists of a modified Model 34 KSR teletype and a local memory unit. The unit is independent of the particular computer, and is easy to test and maintain. The states of the memory control and memory words are observable directly by indicator lights. An application of the memory to the automatic set-up and control of an analog computation are displayed on an oscilloscope; this makes possible, for example, the rapid display of time response of linear systems, under digital program control. Author (TAB)

N68-15373# Massachusetts Inst. of Tech., Cambridge.
PROGRAM ANALYSIS BY DIGITAL COMPUTER
Daniel U. Wilde (Ph.D. Thesis) Aug. 1967 207 p refs
(Contract Nonr-4102(01); Proj. Mac)
(MAC-TR-43; AD-662224)

Comparing properties of non- and self-modifying programs leads to the definition of independent and dependent instructions. Non-modifying programs contain only independent instructions, and such programs can be analyzed by a straight-forward, two-step analysis procedure. First, program control flow is detected; second, that control flow is used to determine program data flow or data processing. However, self-modifying programs can also contain dependent instructions, and then program control flows and data flows exhibit cyclic interaction. This cyclic interaction suggests using an iterative or relaxation analysis technique. Initially, the relaxation procedure determines a first approximation to control flow; the second step, to data flow. These two steps are repeated until steady-state condition is reached. Algorithms for implementing the first iteration are presented. These algorithms are capable of analyzing programs which modify their control and processing instructions while executing. Also described are data structures which permit constructing functional expressions for data flow or information processing. Finally, actual output flowcharts of self-modifying programs are displayed. Author (TAB)

N68-15421*# Stanford Univ., Calif.
MIXED INTEGER PROGRAMMING ALGORITHMS FOR SITE SELECTION AND OTHER FIXED CHARGE PROBLEMS HAVING CAPACITY CONSTRAINTS
Paul Gray 30 Nov. 1967 158 p refs Sponsored by NASA
(Contracts Nonr-225(53); Nonr-225(89); DA-49-092-ARO-10; Grant NSF GP-7074)
(NASA-CR-91906; TR-101) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Algorithms are presented for solving site-selection and similar fixed-charge problems with upper bound constraints. These problems typically arise in the following way: a number of sites are known to be available at which facilities can be established for performing a given service. The set of facilities must provide service at a specified level of effectiveness. Fixed costs are associated with each site if a facility is opened there, and variable costs are associated with operations. Upper-bound constraints on the allowable size of a facility at each site must be taken into account. The problem to be solved by the operations researcher is to select a subset of the available sites which meets the constraints and minimizes the total cost. The basic approach to obtaining algorithms for the exact solution of the fixed charge problem is to formulate them as mixed integer programs and to solve these programs by decomposing them into a master problem (which is an integer program) and a series of subproblems which are linear programs. As in all decomposition schemes, heavy use is made of the fact that large portions of the constraint matrix contain only zero elements. A theorem of Dantzig and Hirsch, which states that an optimal solution of the fixed-charge problem must occur at an extreme point, plays a central role. Vertices were reduced to manageable proportions by adapting the bound-and-scan integer programming algorithm to the fixed charge problem. Author

N68-15437*# Museum of Science, Boston, Mass.
SPACEBORNE MULTIPROCESSING SEMINAR
1966 93 p refs Seminar held at Boston, 31 Oct. 1966 Sponsored by NASA
(NASA-CR-91825) CFSTI: HC $3.00/MF $0.65 CSCL 09B

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10. ON-LINE SIMULATION IN THE OPS SYSTEM M. Greenberger and M. M. Jones (MIT) p 83–85 (See N68-15447 06-08)

N68-15438*# Autonetics, Anaheim, Calif.
MULTIPROCESSOR ORGANIZATION FOR MANNED MARS MISSION
A. Williman, L. Koczela, and G. Burnett *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 5–10 refs (See N68-15437 06-08)

Three different approaches to computer organization for a long duration manned space mission are given. Flexibility in meeting computational requirements is an important factor in the computer system design. The organizations are currently being evaluated, and preliminary evaluations indicate that a multiprocessor or distributed logic approach offers the most potential for future space missions. Author

N68-15439*# Bellcomm, Inc., Washington, D. C.
FUNCTIONAL REQUIREMENTS OF SPACEBORNE COMPUTERS ON ADVANCED MANNED MISSIONS
E. L. Gruman and P. S. Schaenman *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 13–19 refs (See N68-15437 06-08)

In addition to present day functions, the onboard computer system would provide capability for: (1) monitoring, confidence testing, and diagnostic testing for spacecraft subsystems and experiments; (2) inflight crew training with simulations; (3) control and data management for experiments; (4) displays for flight and experiment operations; and (5) G&N of unmanned probes launched from the mother craft. It is concluded that: (1) The functions (G&N, attitude control) which originally justified using onboard computers are no longer the pacing factors in determining many system characteristics. (2) Mission complexity will force the crew to make extensive use of computer system support. (3) The growth of computer usage in spaceborne scientific experimentation will parallel the historical surge evident in ground-based experimentation. (4) Increased functional requirements will result in a greatly increased number of I/O channels, increased high speed memory, the addition of off-line bulk storage and more powerful processing capability, regardless of the specific system configuration. (5) The amount of onboard software required for a manned flyby mission will be large relative to manned missions heretofore. Author

N68-15440*# Massachusetts Inst. of Tech., Cambridge. Instrumentation Lab.
DESIGN CRITERIA FOR A SPACECRAFT COMPUTER
Ramon L. Alonso, Albert L. Hopkins, Jr., and Herbert A. Thaler *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 23–28 (See N68-15437 06-08)

Extrapolation of Apollo experience to spacecraft computers of the next generation indicates a need for digital systems of greater computing and interface activity, and of greater reliability, than has been realized to date. An idealized collaborative multiprocessor structure in which a number of processing elements are tied together by means of a single multiplexed data bus is explored. At least one job assignment procedure is possible for which no one processor has to act as 'master', and which can survive processor malfunctions or the deletion or addition of processors to the bus, thus accomplishing 'graceful degradation' and 'reconfiguration' of sorts. The single bus structure as used here implies things about compilers for it, and also certain bandwidth relationships between processors, bus and commom memory. Rough estimates based on short extrapolations of circuit technology show that the structure is probably realistic. Author

N68-15441*# Autonetics, Anaheim, Calif.
EXECUTIVE PROGRAM CONTROL FOR SPACEBORNE MULTIPROCESSORS
Robert A. Hokom *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 31–35 (See N68-15437 06-08)

The necessity for executive program control, a description of executive functions, and executive software implementation is discussed. The frame of reference is a spaceborne computer for a manned Mars mission. The reasons for having executive program control include requirements for reconfiguration to handle failures, computational loading, and unanticipated processing as well as the general questions of efficiency and timing. The executive functions described are program scheduling, inter-program communication, reconfiguration control, request processing, input/output supervision, and computer self-test. The application of these functions for a multi-module computer, which is representative of many multiprocessors, illustrates their characteristics. Differences in executive implementation for other configurations are briefly discussed. Author

N68-15442*# Sperry Rand Corp., St. Paul, Minn. UNIVAC Defense Systems Div.
SELF-REPAIR: FAULT DETECTION AND AUTOMATIC RECONFIGURATION
Earl C. Joseph *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 41–49 refs (See N68-15437 06-08)

Included is a description of the fault detection, isolation, and location techniques required to recognize a system failure, to make the necessary real-time self-repair adjustments to the hardware configuration, and recover from errors generated. The multiprocessor organization with nonmanual self-repair features allow for reconfiguration so that a level of capability is continuously maintained and 100 percent systems availability can be virtually assured. Author

N68-15443*# Michigan Univ., Ann Arbor.
ARITHMETIC ERROR CORRECTION
Harvey L. Garner *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 53–57 refs (See N68-15437 06-08)

Classification and properties of arithmetic codes are briefly reviewed. A logical circuit for the determination of the modulo three residue is presented and the expected performance of this circuit is analyzed, using the assumption that the errors events follow a binomial distribution. The modulo three check circuit operates faster than the conventional adder carry logic and the statistical analysis indicates that the circuit is practical. Author

N68-15444*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SYSTEM ORGANIZATION OF THE JPL SELF-TESTING AND REPAIRING COMPUTER AND ITS EXTENSION TO A MULTIPROCESSOR CONFIGURATION
Algirdas Avizienis (Calif. Univ., Los Angeles) *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 61–66 refs (See N68-15437 06-08)

The techniques for the application of protective redundancy in digital systems are reviewed and compared. The choice of a replacement system as protective redundancy for a spacecraft guidance and control computer is reached by consideration of its computing requirements. The system organization of an experimental replacement system is described, with emphasis on the method of concurrent fault diagnosis by means of arithmetical encoding. An extension of the system to a multiprocessor configuration is considered as a means to provide onboard data processing after arrival at a remote destination. Author

N68-15445*# Honeywell, Inc., St. Petersburg, Fla. Aeronautical Div.
COMPUTER DESIGN ASSISTANCE FOR THE EVOLVING LARGE SCALE INTEGRATED CIRCUIT TECHNOLOGY
John S. Merritt *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 71–76 (See N68-15437 06-08)

The design of a multiprocessor computer system will be developed with the aid of an existing computer. A tool box of programs is presented which have in common the fact that they all work on the same reel of magnetic tape. This tape contains files specifying the design of a particular unit. The operational steps in execution of selected program tools for a particular equipment design fall into four general categories: (1) formulation of logic, (2) simulation of operation, (3) placement of components, (4) preparation of wire-run lists. Each operational step may be thought of as a different shelf in a tool box. On each shelf are several program tools which may be selected by the designer. The objective of these tools is to provide a cooperative man–machine interactive design system which frees the designer from routine bookkeeping tasks so that he may devote more of his time to the actual system design. Author

N68-15446*# Massachusetts Inst. of Tech., Cambridge.
ESSENTIAL FEATURES OF ON-LINE SYSTEMS
Harry D. Huskey (Calif. Univ., Berkeley) *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 79–80 (See N68-15437 06-08)

Time sharing, on-line, and batching techniques are briefly compared. The state-of-the-art in on-line computer operations is reviewed, and the Project Genie on-line system at the University of California is described. Differences in hardware and software designs based on user proficiency are mentioned. E.C.

N68-15447*# Massachusetts Inst. of Tech., Cambridge.
ON-LINE SIMULATION IN THE OPS SYSTEM
Martin Greenberger and Malcolm M. Jones *In* Museum of Sci. Spaceborne Multiprocessing Seminar 1966 p 83–85 (See N68-15437 06-08)

The On-Line Process Synthesizer (OPS) system, an interactive system designed for use in a time-sharing environment, includes an on-line simulation capability. A simulation activity, thought of as a series of events, is scheduled, canceled, or rescheduled dynamically on the AGENDA, either at a specified time, or when a prescribed condition is met. The activity can be made to consume simulated time by means of an internal delay for a certain period, or a wait until given conditions are satisfied. The AGENDA is a time-ordered list of all conditionally and unconditionally scheduled activities. The user may inspect it at any point in a simulation, and personally modify or restructure it. He may base his strategy on data and partial results examined and analyzed with the help of the OPS system during interruption of the run. Extensive tracing facilities permit the user to follow the flow of control during a simulation to any level of detail. Author

N68-15461 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELEMENTS OF CYBERNETIC SYSTEMS
1 May 1967 83 p refs Transl. into ENGLISH from the Publ. "Elementy Kiberneticheskikh Sistem" Tbilisi, An Gruzssr., 1964 p 29–43, 45–77, 89–99, 101–106, 141–153, and 155–162 (FTD-MT-66-61; AD-662549)

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6. THE QUESTION OF DIGITAL COMPARISON IN GRAY CODE FROM LOW-ORDER BITS Yu. S. Manukyan, M. V. Chkheidze, and G. A. Machavariani p 55–64 refs (See N68-15467 06-08)

7. SUBTRACTION OF BINARY NUMBERS IN STRAIGHT CODE IN HIGH-SPEED COMPUTERS M. G. Gogoberidze and T. V. Dolidze p 65–71 refs (See N68-15468 06-08)

N68-15462 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VOLTAGE-TO-CODE CONVERTER [PREBRAZOVATEL NAPRYAZHENIYA V KOD]
M. V. Chkheidze, T. B. Abesadze, N. L. Melikadze, and V. I. Shekriladze *In its* Elem. of Cybernetic Systems 1 May 1967 p 1–11 (See N68-15461 06-08)

This article discusses converters of low voltages into code. These converters use high precision electrical measuring devices with luminous dials which are replaced by special coding matrices, made of coherently organized optical fiberglass. The converter makes use of a metering device which measures reflected light rays. This device takes its reading from the screen of the dial. If each

element is connected to some register, which is not connected with other elements, there will be a separate signal for each variation in the input voltage. Author

N68-15463 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONVERTER OF CONTINUOUS VALUES INTO DISCRETE [CONVERTER PREOBRAZOVATEL NEPRERYVNYKH VELICHIN V DISKRETNYYE]
M. V. Chkheidze, G. A. Machavariani, Yu. S. Manukyan, and V. I. Shekriladze *In its* Elem. of Cybernetic Systems 1 May 1967 p 13–21 refs (See N68-15461 06-08)

This article describes a simple converter built on transistors for conversion of voltage into a proportional number of pulses. Results of the experimental investigation and determinations of its errors are given. It is shown that with the selected circuit of temperature compensation and a corresponding selection of transistors, inaccuracy of the converter can be brought to 0.1%. Author

N68-15464 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
COUNTERS WORKING IN GRAY CODE [SCHETCHIKI, RABOTAYUSHCHIYE V KODE GREYA]
Yu. S. Manukyan *In its* Elem. of Cybernetic Systems 1 May 1967 p 23–37 refs (See N68-15461 06-08)

This article reviews the existing Gray code counters. First, these counters are classified according to the principle of Gray code formation in the counter itself. The design characteristics of Gray code counters are discussed. The most common and important characteristic of the design of Gray code counters is the method of producing the code in the counter itself. The circuit is built to add "one" to a quantity (direct counting), and to subtract "one" from a quantity (reverse counting). Author

N68-15465 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE METHOD OF CODE VOLTAGE CONVERSION USING A GRAY CODE COUNTER [OB ODNOM SPOSOBE PREOBRAZOVANIYA KOD-NAPRYAZHENIYE S ISPOL'ZOVANIYEM SCHETCHIKA KODA GREYA]
Yu. S. Manukyan, M. V. Chkheidze, G. A. Machavariani, and G. V. Datiashvili *In its* Elem. of Cybernetic Systems 1 May 1967 p 39–47 refs (See N68-15461 06-08)

The authors propose the following method: During each conversion cycle, a count of the separate pulses, having a constant frequence *f*, is made in the same system in which the number being converted is expressed. The values of the results obtained from this are continuously compared with the quantity being converted until they are equal. The time interval t_1 from the beginning of the count until the quantities become equal is taken as the equivalent of the number to be converted and is used for pulse width modulation of a source of stabilized direct voltage or current. Author

N68-15466 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NEW METHOD AND DEVICE FOR RAPID DECIMAL BINARY CONVERSION [NOVYY SPOSOB I USTROYSTVO BYSTROGO PREOBRAZOVANIYA DESYATICHNYKH CHISEL V DVOYCHNYYE]
M. G. Gogoberidze *In its* Elem. of Cybernetic Systems 1 May 1967 p 49–63 refs (See N68-15461 06-08)

The article gives a new method and device for translation from decimal system into binary in digital computers. Instead of the standard subprogram by which present translation of numbers is carried out, the new method makes it possible to carry out translation of only one instruction. The method is based on a method of multiplication by "ten," easily realizable in computers. The method decreases time of translation of a number from one system into another almost one hundred times, and increases the volume of immediate store because it is released from the standard subprogram, which increases high speed operation and effectiveness of computer during solution of problems. Author

N68-15467 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION OF DIGITAL COMPARISON IN GRAY CODE FROM LOW ORDER BITS [K VOPROSU PORAAZRYADNOGO SRAVNENIYA V KODE GREYA, NACHINAYA S MLADSHIKH RAZRYADOV]
Yu. S. Manukyan, M. V. Chkheidze, and G. A. Machavariani *In its* Elem. of Cybernetic Systems 1 May 1967 p 55–64 refs (See N68-15461 06-08)

An algorithm is formulated for logical comparison of two numbers directly in Gray code without the preliminary operation of Gray-to-binary code conversion, which is desirable in many digital automatic regulation and control systems. Logic circuits of units for place-by-place comparison of serial gray codes transmitted beginning with the least significant digit are examined. The possibility of performing this type of comparison using one trigger with separate inputs is considered. It is demonstrated that comparison beginning with the least significant digit is the most effective method in information converters with feedback, digital servosystems, etc. Three proposed circuits, whose block diagrams appear in the article can also be used to compare static (parallel) Gray codes if they have units for sequential scanning of parallel codes at their inputs. Author

N68-15468 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SUBTRACTION OF BINARY NUMBERS IN STRAIGHT CODE IN HIGH SPEED COMPUTERS [VYCHITANIYE DOVICHNYKH CHISEL V PRYAMOM KODE V BYSTRODEYSTVUYUSHCHIKH VYCHISLITEL'NYKH MASHINAKH]
M. M. Gogoberidze and T. V. Dolidze *In its* Elem. of Cybernetic Systems 1 May 1967 p 65–71 refs (See N68-15461 06-08)

An auxiliary subtraction unit for high-speed computers is proposed which would perform the subtraction operation directly, without code conversion. In this unit the output of the trigger of each digit place leads to two gates, one of which is used for continuous carry, and the other for carry over (borrow). In the continuous carry circuit is a pulse generator which forms a specially shaped pulse whose leading edge controls the continuous carry gate; the trailing edge of this pulse is used to actuate the trigger of the next most significant digit place. According to the authors, a "BESM" computer can perform an addition in 1.5 microseconds, but a subtraction takes 2.7 microseconds using numerical code conversion. Using the proposed unit it could perform a subtraction in 1.5 microseconds, thus considerably increasing the speed of the computer. Application of this subtraction method to a computer would require a greater number of standard elements but would do away with the need for all units for inverse transcription of numbers, thus increasing the average speed of the computer. Author

N68-15569 Joint Publications Research Service, Washington, D. C.
CLASSIFICATION OF STRUCTURES OF ALGORITHMS EXECUTED ON COMPUTER SYSTEMS
D. A. Pospelov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 174–183 refs (See N68-15576 06-10)

This article contains an investigation of a representation of algorithms in parallel level form convenient for evaluation of their

structure from the point of view of efficiency of the computation system. A number of numerical characteristics are introduced on the basis of which the classification of the algorithms is constructed. Problems are investigated connected with simulation of the structures of the algorithms in order to find the system of discriminate functions distinguishing them in accord with the efficiency of the computation system. Author

N68-15650# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RELIABILITY OF THE MANUFACTURE OF ELECTRONIC COMPUTING MACHINES
P. P. Mesyatsev 27 Apr. 1967 241 p refs Transl. into ENGLISH of "Nadezhnost' Proizvodstva Elektronno-Vychislitel'nykh Mashin" Moscow, Gosgeoltekhizdat. p 1–216
(FTD-MT-65-514; AD-662213)

The book deals with the theory and method of engineering and calculating the exactness, reliability, and effectiveness of electronic computing machines, when manufacturing them. The book is intended for technical engineers, who are connected with the designing of electronic equipment. TAB

N68-15669# Royal Aircraft Establishment, Farnborough (England).
A COMPUTER PROGRAM FOR THE DERIVATION OF TRANSFER FUNCTIONS IN TERMS OF PARTIAL FRACTIONS BY A MATRIX METHOD
J. M. Freeland Sep. 1967 12 p ref
(RAE-TR-67234) CFSTI: HC $3.00/MF $0.65

Mercury autocode program 338 was written to calculate the coefficients in the partial fraction expansion of the transfer function for a linear system directly from its linear first order differential equations. Author (ESRO)

N68-15678# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALOG COMPUTER FOR PERFORMING CONFORMAL TRANSFORMATIONS [ANALOGOVOYE VYCHISLITEL'NOYE USTROYSTVO DLYA VYPOLENENIYA KONFORMNOGO PREOBRAZOVANIYA]
A. N. Suprun 14 Jul. 1967 8 p Transl. into ENGLISH from Russian Patent no. 155626 (Appl. no. 792187/26-24, 25 Aug. 1962) 2 p
(FTD-HT-23-832-67; AD-662767)

A computer is suggested which would reproduce the boundaries of singly- or doubly-connected regions on the screen of a CRT. The distinguishing characteristic of the circuit is the means of forming the voltages (for the deflecting plates of the tube) corresponding to the coordinates of the function and formed by summation of sinusoidal voltages. For synchronication of the voltage frequencies, the summed sinusoids are formed with the aid of filters and amplifiers whose inputs receive the output voltage from a common generator of periodic complex-form voltages. TAB

N68-15679# Standard Electrik Lorenz A. G., Stuttgart (West Germany).
STUDY ON FERRITE STORE FOR DATA PROTECTION [UNTERSUCHUNGEN UEBER FERRITSPEICHER ZUR DATENSICHERUNG]
T. A. Onciul and F. F. Tsui Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Jun. 1967 29 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-10)

A ferrite core store of large capacity (up to 2 million bits) is to be developed for the temporary storage of telemetering data in satellites. The store is to use ferrite cores having an outside diameter of 0.5 mm. Its volume, weight and power dissipation shall be reduced to a minimum. Compared to the conventional coincidence store, the expenditure for addressing is to be cut by one half. By switching off the power supply during the intervals between storage cycles, the mean power consumption can be decreased by several orders of magnitude. To the extent integrated semiconductor circuits are not available, miniaturized multichip or thin film circuits should be used. Author

N68-15686*# Harvard Univ., Cambridge, Mass. Div. of Engineering and Applied Physics.
TWO CONVERSATIONAL LANGUAGES FOR CONTROL THEORETICAL COMPUTATIONS IN THE TIME SHARING MODE
P. M. Newbold and A. K. Agrawala Nov. 1967 55 p refs
(Grant NGR-22-007-068; Contracts N00014-67-A-0298-0006; N00014-67-A-0298-0005; N00014-67-A-0298-0008)
(NASA-CR-92515; TR-546) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The paper presents, in the form of users' manuals, a description of two conversational languages for use on a direct-access time-sharing computer. The languages are designed for control-theoretic applications. The first is a matrix manipulation language, the second is designed to simulate linear dynamic systems and to solve the associated Riccati equations. Further applications are also possible. Each manual includes detailed examples of the usage of the languages. Author

N68-15745*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
DATA FORMAT CONVERTER
J. W. Fennel, Jr. and R. J. Stattel Dec. 1967 55 p
(NASA-TM-X-63070; X-721-67-603) CFSTI: HC $3.00/MF $0.65 CSCL 09B

The Data Format Converter accepts nine-bit parallel binary data at a 5-kilohertz rate, combines the data with time readings, and records them on a one-half inch 7 track computer-compatible binary tape. The converter is a part of a pulse position modulation (PPM) telemetry system, which is used extensively for sounding rocket flights. The computer compatible tape can be processed by a computer to analyze the results of rocket flight experiments and instrumentation performance. Author

N68-15752# Atomic Energy Establishment, Winfrith (England). Reactor Group.
THE RAPID CALCULATION OF FREQUENCY RESPONSES FOR LINEAR SYSTEMS INVOLVING TIME-DELAYED TERMS (FORTRAN PROGRAM FRP Mk 2)
Helen M. Sumner Jul. 1967 45 p refs
(AEEW-R-539) HMSO: 6s

The present report considers the minimization of time and storage requirements. In particular, if the system is described by a set of first order differential and algebraic equations, some variables, specified by the programmer may be eliminated by the computer. The method is incorporated in the KDF 9/EGDON code FRP Mk 2, and includes special non-numeric, compiler subroutines for input of the equations and other data in a simple form orientated towards the analyst. The input scheme used for the equations is compatible with that used for the pole-zero, or transfer function program, ZIP so that the same card-deck may be used for data entry in both codes. The code FRP Mk 2 was designed to be used for the analysis of nuclear reactor power systems, but is equally applicable to most forms of process plant, especially chemical plant. Author

N68-15775# Wolf Research and Development Corp., West Concord, Mass.
SPECIAL UTILITY PROGRAMS TO ENHANCE THE PERFORMANCE OF AN ON-LINE MEDIUM SIZE PROCESSOR USED FOR STATISTICAL INFORMATION EXTRACTION AND EVALUATION Final Report, 1 Oct. 1966–30 Sep. 1967
Raymond J. Arsenault, Virginia M. Flynn, Lee B. Metrick, Nancy V. Pitblado, and J. Richard Wright 30 Sep. 1967 76 p refs
(Contract AF 19(628)-67-C-0095)
(AFCRL-67-0605; AD-662872)

A new method for determining eigenvectors and eigenvalues in the Attribute Extraction Process is described. A software package for the new floating point arithmetic unit of the Experimental Dynamic Processor, a visual documentation system for DEXTER programs, and a general data display are described. Several debugging programs, graphic software, special display programs, and utility routines are presented. Author (TAB)

N68-15782# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINT READER DESIGNED ON OPTICAL CORRELATION PRINCIPLE [CHITAYUSHCHIY AVTOMAT, POSTROYENNYY NA PRINTSIPE OPTICHESKOY KORRELYATSII]
V. K. Yeliseyev 25 Apr. 1967 33 p refs Transl. into ENGLISH from Akad. Nauk. Ukr. SSR. Chitayushchiye Avtomaty i Raspoznavaniye Obrazov (Kiev), 1965 p 208–233
(FTD-MT-66-117; AD-662382)

A prototype of a reading automaton based on optical correlation is described. It operates in conjunction with the Kiev computer and is designated for the recognition of numbers typed by the Moskva typewriter. The algorithm is based on the correlation method for standard pattern recognition developed at Institute of Cybernetics, An UkrSSR. The modeling of this approach on computers showed a high level of recognition in presence of poor quality of typing. The article outlines the principle optical correlation and describes the experimental setup. A description is also given of the realization of the shifts of the pattern under study relative to the standards, the block diagram of the reading automaton and the Kiev computer, and the machine algorithm. The tests showed that (1) the proposed simple setup secures a reasonably reliable operation; (2) the experimental results are in good agreement with the modeling results; (3) the speed is limited by the paper advancing rate of the drum (3000 rpm); (4) the recognition process organization requires the use of special memories; and (5) the major shortcoming is the relatively slow rate of the mechanical sign shifts. TAB

N68-15798*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUMERICAL PROCEDURES FOR CALCULATING REAL FLUID PROPERTIES OF NORMAL AND PARAHYDROGEN
Fredric N. Goldberg and Angela M. Haford Washington Feb. 1968 62 p refs
(NASA-TN-D-4341) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The library of single function calls can be used efficiently without initial estimates. When physical conditions are known, engineering estimates of density may be included for additional speed in calculation. The procedures are designed to calculate a specified function of one or two input parameters. Independent variables consist of the combinations temperature-density, pressure-density, temperature-pressure, enthalpy-pressure, or entropy-pressure. Ideal and saturation properties may also be calculated as functions of either temperature or pressure. The program is written in separate modules that can be modified easily in the future to include new data. These modules can be used as a subset of functions when computer space is not available for the entire library in complex programs. The discussion includes techniques used, resolution of inherent physical and mathematical problems, and consistency of results based on National Bureau of Standards data. Computer time and storage estimates are given with a manual of instructions for the programmer. A listing of the program is included as used in the library of functions at the Lewis Research Center. Author

N68-15829# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTRODUCTION TO THEORY OF DIGITAL INTEGRATORS
A. V. Kalyayev 29 Mar. 1967 277 p refs Transl. into ENGLISH of the book "Vvedeniye v Teoriyu Tsifrovykh Integratorov" Kiev, Naukova, Dumka, 1964 p 1–291
(FTD-MT-65-215; AD-662456)

The book presents questions on the theory of digital integrators which are main units of digital integrating machine. General methods of analysis of the process of numerical integration in digital integrators are considered. Obtained results are based on synthesis of algorithms of digital integrating, differentiating, factoring, dividing, and summing units, operating with incremental flows. Errors of digital integrators are investigated. Topics included are: Digital-analog computers; Numerical methods of integration in digital integrators; Quantization of quantities in digital integrators and delta transformation of continuous functions; Algorithms digital integrators; Serial and parallel digital integrators; Encoding of numbers and increments in digital integrators; Mathematical operation with flows of increments; Functional diagrams of digital integrators; Errors of digital integrators. TAB

N68-15831# Burroughs Corp., Paoli, Pa.
AUTOMATIC DETECTION OF PARALLELISM IN COMPUTER PROGRAMS Quarterly Report, 22 Apr.–22 Jul. 1967
Harvey W. Bingham, David A. Fisher, and Earl W. Reigel Nov. 1967 90 p refs
(Contract DA-28-043-AMC-02463(E))
(ECOM-02463-4; TR-67-4; QR-4; AD-662274)

The object of the first year of this research has been to establish the desirability and feasibility of automatically recognizing parallelism in computer programs written in compiler languages, given suitable machine organizations capable of parallel or concurrent execution. An algorithm for formal analysis of programs is described. This algorithm detects implicit parallelism that exists between parts of a given sequentially ordered program from the input-output set intersections and any initially known essential serial order. The algorithm can be applied to program structures including subroutines, loops, conditionals, recursive subroutines, arrays, and serial input-output calls. To demonstrate that the automatic recognition of parallelism is feasible, a simulation based on the algorithm has been programmed on the Burroughs B5500 for analysis of compiler language programs. The source language for the programs to be analyzed (a subset of ALGOL), a description of the simulation, example programs for analysis, and the results of parallelism detection are given. Desirability is dependent on having machine organizations capable of using the parallelism effectively. The relation between parallelism in programs and the machine organizations will be investigated in future reports. Author (TAB)

N68-15854*# Auburn Univ., Ala. Dept. of Industrial Engineering.
TELEPROCESSING SYSTEM 7740–7010 WORKLOAD ANALYSIS Final Report
Dec. 1967 49 p
(Contract NAS8-18049)
(NASA-CR-61468) CFSTI: HC $3.00/MF $0.65 CSCL 09B

Developed is a simulation model for analyzing the impact of added terminals and/or workloads on a teleprocessing system, and for predicting at what time an excessive turnaround will result

from overload. The workload study indicates that most of the entries are a result of the inventory system; the video tape management system also contributes to the load as it increases with activity. The developed 7740–7010 data processing system can be simulated by a general purpose simulator and is able to evaluate the cost effectiveness of a computer system before a contract is given.
G.G.

N68-15944# University of Southern Calif., Los Angeles. Electronics Personnel Research Group.
COMPUTER PERSONNEL SELECTION AND CRITERION DEVELOPMENT. 3: THE COMPUTER POSITION PROFILE
Joseph W. Rigney, Raymond M. Berger, and Robert C. Wilson Nov. 1967 43 p refs
(Contract Nonr-228(22))
(TR-53; AD-662671)

The Computer Position Profile (CPP), was developed as a means of describing and analyzing the important dimensions of computer programmer and analysts positions. The CPP grew out of the job analysis phase of a long range research program concerned with computer personnel selection and evaluation. As the result of a Q-factor analysis of 150 computer positions in a variety of computer installations, common job factors or dimensions were found and interpreted. The dimensions were interpreted on the basis of the kinds of positions defining each dimension and the tasks most often performed in these positions. A scoring key was constructed for each dimension using the 10 highest-weighted tasks and 10 lowest-weighted tasks in the analysis as positive and negative weights, respectively. The original 150 positions were rescored with these keys. Congruence coefficients between the dimension scores and the original factor loadings were quite high, indicating that the scoring keys based on 20 items will retain the same dimensional structure. C-score norms were then developed for converting the scores to C-scores on a profile sheet. An application was made of the CPP on a group of computer personnel in a large military systems programming organization. The results of this application of the CPP were consistent with the type of programming activities carried on by the three broad job categories: Systems Analyst, Senior Programmer and Programmer. The CPP is recommended as an economical procedure for measuring some of the dimensions of computer personnel positions for purposes of job description, personnel assignment, and training evaluation. An application of the CCO is seen in career development programs.
Author

N68-16005*# Nuclear Data, Inc., Palatine, Ill.
RESEARCH AND DEVELOPMENT STUDY ON MULTIMODE SYSTEM APPLICATIONS IN THE AREA OF TIME OF FLIGHT AND COINCIDENCE MEASUREMENTS
William J. O'Neill and Gerald W. Gaughran Oct. 1967 97 p refs
(Contract NAS12-516)
(NASA-CR-86023) CFSTI: $3.00 CSCL 09B

Details are given on a multimode digital storage device which incorporates a 4096 channel memory with 20 binary bit storage, a 4μsec memory cycle time, 16 megahertz analog to digital converters, and built-in arithmetic capability. Display and data manipulation are incorporated to provide visual interpretation techniques. The analog to digital converters contain inputs for unipolar and bipolar pulses, coincidence and anticoincidence inputs, and dc or slowly varying ac signal analysis. The research areas for which such a system can be used are listed, with attention focused on digital time of flight measurements, and on both single and multidimensional coincidence experiments. The basic design of the time of flight unit incorporates a time range which is switch-selectable in 10 steps: the range is variable from 0.25 μsec/channel to 128 μsec/channel; and time uncertainty is reduced through the use of a prescaler, and a double derandomizing circuit incorporated within the prescaler. Work on the coincidence systems centered about the time pickoff/delay module, and the coincidence gate module. Instruction manuals and data sheets are included.
M.G.J.

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N68-15008# Litton Industries, San Carlos, Calif. Electron Tube Div.
STUDY OF HIGH POWER ELECTROSTATICALLY FOCUSED KLYSTRONS Final Report, 1 May 1966–28 Aug. 1967
T. H. Luchsinger and W. R. Day Nov. 1967 86 p refs
(Contract DA-28-043-AMC-02253(E); ARPA Order 436)
(ECOM-02253-F; AD-662070)

The report covers a program of experimental study to establish the feasibility of employing higher perveance beams in ESFKs, which together with other broadband techniques (filter, extended interaction cavity) would lead to ten percent bandwidth. In order to keep the tube design as simple as possible, the program was undertaken only to study the feasibility of employing higher beam perveances in ESFKs. In addition to the experimental study, further theoretical studies were made on a triple-gap extended interaction cavity leading to a 1 MW peak power C-band klystron with ten percent bandwidth. Studies of beam power and perveance limits for ESFKs were made. An improved method was developed for calculating small-signal gain of ESFKs which accounts for the effect of the electrostatic field of the lens on the electron bunching process. During the program, one beam tester and one electrostatically focused klystron were built. By utilizing very low perveances (0.0000008 A/V to the 3/2 power) efficiencies of up to 43 percent were achieved. By increasing the perveance to 0.0000015 A/V to the 3/2 power the efficiency dropped to 36 percent. Beam perveances higher than approximately 0.00000175 A/V to the 3/2 power do not appear useful in ESFKs.
Author (TAB)

N68-15045# Technische Hochschule Hannover (West Germany).
EXPANSION OF THE TRIGGER MECHANISM OF CURRENT LIMITING SWITCHING APPARATUS TO IMPROVE THE TRIGGERING PRECISION AND OBTAIN SELECTIVITY [ERWEITERUNG DER AUSLOESEEINRICHTUNG VON STROMBEGRENZENDEN SCHALTGERAETEN ZUR ERHOEHUNG DER AUSLOESEGENAUIGKEIT UND ERZIELUNG VON SELEKTIVITAET]
Sarbesh Chandra Roy (Ph.D. Thesis) 1966 128 p refs In GERMAN

Dynamic and thermal loads of short circuits in electrical power distribution systems are regulated by switching arrangements that limit the power surge before crest voltage is reached. By introducing additional circuit breakers, the stray angle contact effect on the triggering time of electric relays is sensitized. A developed switching device that incorporates the measuring and triggering mechanics of the Is-limiter reduces triggering to 500 μs for short circuit surges. Some calculations are given for selective triggering by limiting current switching devices in high voltage networks.
Transl. by G.G.

N68-15046# Technische Hochschule Hannover (West Germany).
CONTRIBUTION TO THE MEASUREMENT OF STRAY LOSS OF THREE-PHASE SYNCHRON MACHINES [EIN BEITRAG ZUR MESSUNG DER ZUSATZVERLUSTE VON DREHSTROMASYNCHRONMASCHINEN]
Eike Richter (Ph.D. Thesis) 1967 70 p refs In GERMAN

Stray losses in three-phase synchronous motors, and squirrel cage induction motors were studied by running the motors in unsymmetric switching phases. Measurements from unsymmetric runs, results of static tests, and measurements on coil resistance were correlated to obtain the stray loss values. Experimental results showed good agreement with measurements obtained by the reverse rotation test method. Transl. by G.G.

N68-15134# Illinois Univ., Urbana. Dept. of Computer Science.
STEERING CIRCUITRY FOR AN ELECTROLUMINESCENT PANEL
Takehiko Katoh (M.S. Thesis) 18 May 1967 51 p refs
(Contract Nonr-1834(15))
(Rept.-236; AD-662649)

In many cases it is desirable to display the output of information processors by graphical means. One of the top contenders in the display area is the electroluminescent panel in which matrix steering of all display points is possible. Up to now the highly non-linear and time-variable characteristics of electroluminescent panels have led to considerable difficulties in building practical display systems. The system described in this thesis is the outcome of the theoretical investigations concerning the mechanism of electroluminescence and uses a very high voltage pulse super position method. It is felt that the uniformity of a 28 x 28 panel is sufficient and that the access circuitry is of not more than average complication. Author (TAB)

N68-15140# Illinois Univ., Urbana. Coordinated Science Lab.
THE DEVELOPMENT OF A MULTICOLOR PLASMA DISPLAY PANEL
Edward Herman Stradde Nov. 1967 37 p refs
(Contract DAAB07-67-C-0199)
(R-370; AD-662868)

Information can be displayed in several colors on a Plasma Display Panel when phosphors are added to the cells. Experiments have shown that both cathodoluminescent phosphors and phosphors sensitive to ultraviolet light can be excited by the gas discharge in a cell. In addition, it has been observed that the presence of a phosphor on the inside surfaces of the cell does not impair the inherent memory. With rare gases in panels containing cathodoluminescent phosphors, the intensity of the phosphorescence increases with the atomic weight of the gas. Author (TAB)

N68-15161# Harry Diamond Labs., Washington, D. C.
ELECTRONICALLY TUNABLE MICROWAVE BANDPASS FILTER
Ting Hai Mak and Frank Reggia Oct. 1967 33 p refs
(HDL-TR-1359; AD-662215)

An equivalent circuit of two orthogonal striplines coupled by a ferrite (yttrium iron garnet) sphere is derived, using the scattering matrix method. This derivation shows that a nonreciprocal phase shifter can be represented by gyrator networks. Based on this analysis, a YIG bandpass filter, electronically tunable over a very broad frequency range (4:1), is designed by coupling two broadband 180-deg phase shift circuits with a small single crystal YIG sphere. The report also reviews some basic principles pertaining to filter considerations, analyzes the filter circuit of two orthogonal striplines coupled by a ferrite sphere, and synthesizes the equivalent filter circuit by a scattering matrix method. These results describe the operation of the filter circuit under various terminal excitations. Author (TAB)

N68-15215# Bundesministerium fuer Wissenschaftlich Forschung, Bad Godesberg (West Germany).
SIMULATION OF THE RADIATION LOAD CAUSED BY THE VAN ALLEN RADIATION IN SEMICONDUCTOR DEVICES [SIMULATION DER STRAHLENBELASTUNG VON HALBLEITERN DURCH DIE KORPUSKULARSTRAHLUNG VAN ALLEN-GUETELS]
R. Baeuerlein and K. Wohlleben Jun. 1967 107 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-08)

The radiation load of a semiconductor device exposed to the proton and electron component of the van Allen belt has been calculated as a function of shielding thickness. Calculations were performed by ALGOL code on a DVA 2002 computer (Siemens). Investigations concerning the simulation of the van Allen radiation by 1-MeV-electrons, 3-MeV-protons, Co^{60}-γ-rays and 2-MeV-neutrons show that in radiation tests each component of a complex radiation spectrum should be substituted by particles of same kind. Author

N68-15216# Bosch (Robert) GmbH, Stuttgart (West Germany).
EVAPORATED RESISTORS AND DIELECTRICS FOR MICROMINIATURISATION [AUFGEDAMPFTE WIDERSTAENDE UND DIELEKTRIKA ZUR MIKROMINIATURISIERUNG]
K. Kerner May 1967 44 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-07)

The manufacture of reproducible passive circuit elements gives rise to various problems relating to the choice of a suitable substrate material and to the processes of masking and evaporation, which we have set about solving by new methods. The difficulty of cleaning the substrates can in many cases be circumvented by applying a lacquer to the surface. It is also possible to use light plastic substrates. Circuits have been fabricated on such substrates by means of a lacquer masking process. In the evaporation process, the properties of resistive and dielectric layers could be favourably influenced by precisely-controlled reactive evaporation. It appears possible to develop a process which would enable the production of resistances, dielectrics and conductive connections out of a single material. Author

N68-15310# Air Force Cambridge Research Lab., Bedford, Mass.
A BIBLIOGRAPHY OF THE ELECTRICALLY EXPLODED CONDUCTOR PHENOMENON, FOURTH EDITION
William G. Chace and Eleanor M. Watson Oct. 1967 158 p refs Spec. Rept., No. 68
(AFCRL-67-0556; AD-662345)

The bibliography includes abstracts of reports on the exploding conductor (exploding wire) phenomenon published from 1774 through 1966. There is also some coverage of important papers in adjacent areas of spectroscopy and instrumentation. Arrangement is by subject group, alphabetically by authors. Author (TAB)

N68-15481*# Autonetics, Anaheim, Calif.
ADVANCED COMPUTER DORMANT RELIABILITY STUDY Final Report
L. K. Davis, T. G. Schairer, and G. A. Watson 14 Oct. 1967 69 p refs
(Contract NAS12-536)
(NASA-CR-86025; C7-2318/301) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Effect of applied power was studied on the reliability of integrated circuits and discrete components and the relationship between bipolar and MOS integrated circuit reliability, with emphasis on the electronics of the computer and a dormant module for Minuteman II. Minuteman component failure modes were analyzed under "full power" and "no power" input power modes, and theoretical effects on MOS devices subjected to these power inputs were determined. Predicted failure rates were determined for MOS devices for present technology and for the late 1970's on the basis of a reliability transfer model. Future MOS reliability extrapolations and power condition of spare modules in space flight were also considered. M.W.R.

N68-15509# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EDGE EFFECTS IN LINEAR INDUCTION PUMPS [K VORPROSU O KRAYEVYKH EFFEKTAKH V LINEYKH INDUKTSIONNYKH NASOSAKH]
L. Ya. Ulmanis 24 Jul. 1967 20 p refs Transl. into ENGLISH from Tr. Inst. Fiz. Akad. Nauk Latv. SSR (Riga), no. 8, 1956 p 81–94
(Contract AF 33(657)-16408)
(FTD-HT-67-469; AD-663347)

Experimental investigations were made of edge effects in flat linear pumps, and empirical derivations necessary in an engineering examination of longitudinal effects and transverse edge effects in linear induction pumps with open magnetic circuits. TAB

N68-15513# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
TIME JITTER DUE TO NOISE IN TIMING SYSTEMS
P. R. Orman Aug. 1967 7 p
(AERE-R-5561)

Circuit noise gives rise to 'time jitter' in the electrical signals used in timing systems. This may be significant especially when the transducer signals are amplified before being used to give time information. It is shown that because of the relation between amplifier noise and rise-time, minimum time jitter is obtained when the amplifier rise-time is equal to the rise-time of the transducer signal. Author

N68-15529*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
EVALUATION OF DIRECT CURRENT MOTORS IN VACUUM
K. E. Demorest and A. F. Whitaker 24 Nov. 1967 33 p refs
(NASA-TM-X-53675) CFSTI: HC $3.00/MF $0.65 CSCL 09C

Special materials were selected for use on 1/6 horsepower motors which were tested in a simulated space environment. These materials were employed as the bearing retainers, brushes, and in the insulation system. Temperatures of the components were monitored as well as the power out and the torque required by the motor to turn the generator. In general, it was concluded that motor materials are now available which will allow d.c. motors open to the space environment to operate reliably. Author

N68-15551* Astro-Space Labs., Inc., Huntsville, Ala.
DESIGN, DEVELOPMENT, FABRICATION AND PREFLIGHT CERTIFICATION OF AN ABSOLUTE TYPE PRESSURE SWITCH Final Report, 1 Jul. 1966–31 Jul. 1966
Jack Keck 27 Feb. 1967 106 p
(Contract NAS8-20636)
(NASA-CR-61479) CFSTI: $3.00 CSCL 09A

An overview is presented on the design concept selection and the component fabrication and evaluation of an absolute-type pressure switch. Prior to program termination, techniques were developed for fabricating Belleville springs, and formed diaphragms. Three switches were completed and subjected to tests at temperatures between −320° and +165°F during assembly. In addition, vibrational tests were conducted on one switch. Detailed test results are included. M.G.J.

N68-15649*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SEMICONDUCTOR SWITCHES FOR AEROSPACE ALTERNATING-CURRENT POWER APPLICATIONS
James Vrancik Washington Feb. 1968 35 p refs
(NASA-TM-X-1495) CFSTI: HC $3.00/MF $0.65 CSCL 09A

The purpose of this investigation was to obtain insight into the merits and drawbacks of ac static switches, with particular attention to their application as aerospace power switches. Several ac static switches utilizing various semiconductor devices were studied with attention given to power loss, harmonic content, leakage, and temperature effects. The main desirable characteristics are probable high reliability (based on the fact that there are no known wear out modes) and long life, no moving parts, high vibration and shock resistance, and immunity to atmospheric conditions. A specific design was made to provide an example application for the devices and circuits investigated. A breadboard-type three-phase static switch for space use was designed, built, and tested. The breadboard switch was used as a motor starter for a 4-ampere fuel pump motor. The switch performance was determined and the power loss found to be 12 watts while transferring 800 watts (1.4 kVA). Other characteristics determined were harmonic content (≤1.0 percent) and leakage (resistance in off state ≥50 kΩ). The switch was tested over a heat-sink temperature range of −40° to 80°C. Author

N68-15653# Naval Oceanographic Office, Washington, D. C.
UNDERWATER EXPLODING WIRES
James R. McGrath Nov. 1967 13 p refs
(IR-67-87; AD-663085)

The report treats: (1) the shock wave parameters associated with exploding wire phenomena (EWP) under water and (2) their comparison to TNT data. The assumptions, correction factors, and justifications central to the data reduction and analysis are outlined. The equivalent weight of TNT represented by the energy stored in a capacitor is established and justified. In terms of weight, the law of similarity is extended six decades to micropounds. An explosion constant for very rapid, small amplitude explosions is defined. The shock wave parameters of peak pressure and reduced time constant for EWP are found to form similarity curves and are given by the empirical relations: P sub m = 21400 (W to the 1/3 power/R) to the 0.99 power; tau sub e/W to the 1/3 power = 57 (W to the 1/3 power/R) to the minus 0.31 power. Author (TAB)

N68-15670# New Zealand. Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.
A PRECISION PORTABLE OSCILLATOR
W. R. Stephenson, R. A. Morris, and F. H. Ellis Feb. 1967 17 p refs
(TN-186) CFSTI: HC $3.00/MF $0.65

The advent of high frequency silicon transistors has made possible the construction of portable quartz crystal oscillators of high stability. In such devices, the oven control circuits, the oscillator and amplifier and the crystal oven, are all contained in a well regulated outer oven. When the crystal is contained in a double oven, variations in ambient temperature have a small effect on the resonant frequency of the device. Silicon transistors may be operated at the relatively high temperature encountered in the outer oven, while cut-off frequency implies small phase changes in the maintaining amplifier with altering operating point. ESRO

N68-15892# Navy Electronics Lab., San Diego, Calif.
RELIABILITY SCREENING AND STEP-STRESS TESTING OF DIGITAL-TYPE MICROCIRCUITS Research Report, Dec. 1966–Jun. 1967
H. F. Dean and K. F. Harper 1 Sep. 1967 70 p refs
(NELC-1512; AD-662197)

The effectiveness of thermal infrared mapping and nondestructive electrical tests for reliability screening was tested on 100 specimens of an industrial grade digital-type microcircuit. It was shown that more effective screening tests are needed, as a number of early failures were not predictable by the test methods employed. It was also shown that microcircuit containers may be opened for inspection and testing without degrading their reliability. Author (TAB)

N68-15746# City Coll. Research Foundation, New York.
ELECTROSTATIC FOCUSING OF HOLLOW SPIRALING ELECTRON BEAMS Triannual Report No. 2, 1 Apr.–31 Jul. 1967
Morris Ettenberg Nov. 1967 25 p
(Contract DAAB07-C-0159)
(ECOM-0159-2; AD-662244)

A design for an end fire cathode and infection scheme was made. The cathode was electroformed of nickel on an aluminum mandrel. The accelerating anode is to be made of tungsten vanes. The minimum drift length will be four inches and the collector will be segmented to provide information on beam location. The computer calculation for trajectory plotting was revised to take space charge into account. Author (TAB)

N68-15789# Radio Corp. of America, Somerville, N. J. Defense Microelectronics Activity.
HIGH PERFORMANCE THIN FILMS FOR MICROCIRCUITS Quarterly Technical Report, 1 Jun.–31 Aug. 1967
Morton L. Topfer, Joseph H. Mitchell, and Robert L. Schelhorn Nov. 1967 50 p
(Contract DA-28-043-AMC-01230(E))
(ECOM-01230-10; QR-10; AD-662748)

Fabrication of 1-megohm thin-film hafnium resistors (10,000 ohms/sq.) exhibiting temperature coefficients of resistance (TCR) of approximately -900 ppm was accomplished. A complete TCR curve was plotted from experimental data obtained from samples between 6 and 10,000 ohms/sq. deposited on glazed ceramic substrates. Investigation of etching procedures for fine-line resistor patterns to be deposited on passivated silicon wafers was begun. New resistor test patterns were chosen which will yield 1000 individual elements of five different geometries per wafer. Procedures for fabrication of resistors and capacitors using hafnium technology on silicon are outlined. Detailed capacitance-voltage plots of the hafnium-dioxide films indicated the presence of contaminants. Modifications in the fabrication processes eliminated most of the contamination. Characteristics are reported for P-channel MOS devices which were fabricated. Author (TAB)

N68-15892*# General Electric Co., Schenectady, N. Y.
DEVELOPMENT OF HIGH-TEMPERATURE VAPOR-FILLED THYRATRONS AND RECTIFIERS
Arthur W. Coolidge, Jr. Washington NASA Feb. 1968 98 p refs
(Contract NAS3-6005)
(NASA-CR-994) CFSTI: HC $3.00/MF $0.65 CSCL 09A

High-temperature vapor-filled diodes and thyratrons were studied for potential use as power-conditioning elements in future space applications. A 600°C thallium-filled diode was developed using a barium-system cathode. Alkali-halide fills intended for use at 600°C did not produce successful results. Cesium-filled diodes for use at 300°C were also studied. After the accumulation of extensive data from the investigation of diodes, a cesium-filled thyratron was designed and three sample tubes–rated at 15 amperes average, 300 volts forward, and 500 volts inverse–were constructed. One thyratron tube was operated for 1500 hours. Author

N68-15896# International Business Machines Corp., Owego, N. Y. Federal Systems Div.
ANALYSIS OF RADIATION INDUCED COUPLING EFFECTS BETWEEN INTEGRATED CIRCUIT ELEMENTS Scientific Report, 12 May–10 Oct. 1967
W. Cordwell, F. Frankovsky, H. Protschka, and F. Zappert 10 Oct. 1967 83 p refs
(Contract F19628-67-C-0306)
(IBM-67-521-10; AFCRL-67-0571; SR-1; AD-662890)

The report describes the investigation of several elements of an integrated circuit model in the initial phase of a program to analyze pulsed ionizing radiation effects on these elements. The radiation effects on silicon dioxide and semiconductor structures incorporating silicon-dioxide layers are considered. Physical and mathematical models are developed for this analysis. A SCEPTRE simulation was developed to solve the equations of the mathematical model. Experimental techniques are established for future dielectric studies under this program. Also analyzed is the isolation diffusion across the intersection of the NPN or PNP junctions of an isolation diffusion model. IBM recommends that no further effort be expended in this analysis. The transient radiation behavior of a junction FET is reviewed and a synthesis of an equivalent circuit model is described. Author (TAB)

N68-15995*# Westinghouse Electric Corp., Youngwood, Pa. Semiconductor Div.
DESIGN AND DEVELOPMENT OF A HIGH POWER, LOW SATURATION VOLTAGE SILICON SWITCHING TRANSISTOR Quarterly Report
Ernest R. Stonebraker Jan. 1968 11 p Prepared for JPL
(Contracts NAS7-100; JPL-952043)
(NASA-CR-92534; QR-2) CFSTI: HC $3.00/MF $0.65 CSCL 09A

Progress is reported in developing a transistor with a design saturation voltage of 0.07V at 75A collector current. Work on thin wafer, epitaxial, and symmetrical diffusion is summarized. Emphasis during the period was placed on the symmetrically diffused approach. Equipment to implement the selective collector is operational. Photoresist masks are being evaluated. Tables show comparison data for a sunburst geometry design with increased emitter edge length. E.C.

N68-16002# TRW Systems Group, Redondo Beach, Calif.
INVESTIGATION OF RADIATION HARDENED CIRCUIT ELEMENTS
D. A. Mc Williams and N. J. Grannis 15 Aug. 1967 35 p ref
(Contract F19628-67-C-0262)
(TRW-06415-6001-R000; AFCRL-67-0567; SR-1; AD-662127)

A program was initiated to derive radiation hardened insulated gate field effect devices. Initial devices fabricated in silicon three microns thick was completed. The first lots obtained were P enhancement and N depletion devices. The device structures are shown with electrical characteristics. A theoretical derivation of transient currents in these VTT (Very Thin Technique) devices is shown and compared with conventional MOS and dielectrically isolated bipolar transistors. Author (TAB)

N68-16012 Joint Publications Research Service, Washington, D.C.
RECENT DEVELOPMENTS IN SHIPBOARD ELECTRONIC EQUIPMENT
16 Jan. 1968 19 p Transl. into ENGLISH from Sudostroyeniye (Leningrad), no. 11, Nov. 1967 p 54–62
(JPRS-44025)

CONTENTS:

1. DEVELOPMENT OF SHIP ANTENNA EQUIPMENT N. I. Pavlov, E. A. Glushkovskiy, and T. A. Gurgenidze p 1–5 (See N68-16013 06-07)

2. THE "OKEAN" MARINE RADAR SET I. P. Lisenenkov and B. F. Volynets p 6–14 (See N68-16014 06-07)

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see: Specific Physics Categories.

N68-15023# Technische Hochschule Hannover (West Germany).
THE APPLICATION OF THE THEORY OF THE OPTIMAL FILTER ON THE SYNTHESIS OF NONLINEAR CONTROL SYSTEMS [DIE ANWENDUNG DER THEORIE DER OPTIMALEN FILTER AUF DIE SYNTHESE NICHTLINEARER REGELKREISE]
Karl Birnstiel (Ph.D. Thesis) 1967 112 p refs In GERMAN

Examined is the applicability of the Wiener theory of optimal linear filters to the synthesis of nonlinear single control systems with stochastic input signals. Linear and quasi-linear calculations are used for treating optimal linear control as a pure synthesis problem and for dealing with analytical problems arising with the use of the optimal or near-optimal control elements in the control circuit. The accuracy and applicability of quasi-linear calculation methods is analyzed. Transl. by K.W.

N68-15200 Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
A CONTRIBUTION TO THE TREATMENT OF CONTROL CIRCUITS WITH STOCHASTIC SIGNAL INPUTS OF ARBITRARY DISTRIBUTION [EIN BEITRAG ZUR BEHANDLUNG VON REGELKREISEN MIT STOCHASTISCHEN EINGANGSSIGNALEN BELIEBIGER VERTEILUNG]

The purpose of this work was to study the possibility of a quantitative description of the effects of statistical characteristics of stationary, nongaussian random processes in linear and storage-free nonlinear control systems. Easily measurable statistical values were to be used primarily to characterize the random processes which serve as input signals. A simple, nonlinear control circuit is used to demonstrate that the statistical characteristics obtained for this circuit by Booton approximation can be considerably improved by means of the next higher covariance function. The results were verified by calculating a circuit model on an analog computer. Transl. by K.W.

N68-15258 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRIGGER PHENOMENA IN CIRCUIT WITH NONLINEAR CAPACITANCE OF P-N JUNCTION IN PRESENCE OF DC FEEDBACK [TRIGGERNYYE YAVLENIYA V KONTURE S NELINEYNOY YEMKOST'YU P-N PEREKHODA PRI NALICHII OBRATNOY SVYAZI PO POSTOYANNOMU TOKU]
V. I. Samoylenko and I. A. Glotov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 77–92 refs (See N68-15251 06-08)

The capacitance of p-n junction of semiconductor devices as controlled reactance finds the widest application in various electronic devices. In the present article are considered two variants of trigger mechanisms, based on the use of an LC circuit with nonlinear capacitance of p-n junction. Capacitance of the p-n junction as controlled reactance works successfully at very high frequencies. Therefore high frequency triggers built on the principle of the nonlinear circuit with capacitance of p-n junction will possess great speed of operation. At present the frequency limits of the application of the capacitance of p-n junction in resonance systems reach up to 1000 Mc and are limited by purely technological factors (magnitude of ohmic resistance of layer of the p-n junction or Q-factor of the capacitance). Surmounting the technological difficulties will allow us to expand frequency limits of application of this capacitance and to increase still more the speed of operation of the considered trigger mechanisms. It is necessary to bear in mind that the considered trigger mechanisms are distinguished by simplicity of circuit, small number of elements, small dimensions, and great reliability. Therefore they can find wide application where rigid requirements on longevity, space, and weight of equipment are imposed. Author

N68-15259 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STEADY-STATE OPERATING CONDITIONS OF THE TWO-LOOP CIRCUIT OF THE PARAMETRON WITH APPLICATION OF THE CAPACITANCE OF P–N JUNCTION [STATIONARNYY REZHIM PABOTY DVUKHKONTURNOY SKHEMY PARAMETRONA S PRIMENENIEM YEMKOSTI P-N PEREKHODA]
V. I. Samoylenko and I. A. Glotov *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 93–110 refs (See N68-15251 06-08)

Recently in Soviet and foreign literature there have appeared many works devoted to the investigation of parametric amplification and excitation of oscillations. As controlled reactance in the considered devices can be applied ferrites, p-n junctions, and other nonlinear elements. These investigations are based on the assumption that the function of the dependence of the parameter of nonlinear element on voltage (current) can be expanded in power series, and that in considering the physical processes in parametric amplifiers and parametrons it is possible to limit series to the two first members. Such an assumption is correct only for small relative changes of parameter and gives large errors during consideration of amplification of large signals and all the more so during investigation of parametrons. The circuit of the parametron with controlled capacitance of p-n junction can be analyzed without resorting to expansion of control function in power series. Using an accurate dependence between the current and the voltage across capacitances of p-n junction, one can determine conditions of excitation of parametric oscillations, amplitude of oscillations under steady-state operating conditions, and power relationships in the parametron without resorting to complicated mathematical transformations. Author

N68-15260 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE NONSTATIONARY PROCESSES IN THE PARAMETRON WITH CAPACITANCE OF P-N JUNCTION [O NESTATSIONARNYKH PROTSESSAKH V PARAMETRONE YEMKOST'YU P-N PEREKHODA]
V. I. Samoylenko *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 111–128 (See N68-15251 06-08)

This article investigates the nonstationary processes in the parametron with capacitance of p-n junction. The following conclusions are made. 1. To the first approximation it is possible to convert differential equations for the parametron to two joint

linear differential equations with constant coefficients. 2. When current is constant, the principle of linear superposition of subharmonics in circuit applies. 3. For large amplitudes of current in circuit of subharmonics (for a given working region) resistance introduced into pumping circuit, will be increased, which, in turn, evokes a decrease of current and a decrease of Q-factor of the circuit. 4. With large amplitudes effective in the circuit of the subharmonics the principle of linear superposition does not apply.
Author

N68-15281 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF DYNAMIC PROCESSES IN GENERATORS OF SUBHARMONIC OSCILLATIONS BUILT AROUND CAPACITANCE OF P-N JUNCTION [ISSLEDOVANIYE DINAMICHESKIKH PROTSESSOV V GENERATORE SUBGARMONICHESKIKH KOLEBANIY NA YEMKOSTI P-N PEREKHODA]
V. I. Samoylenko and Ye. M. Zlochevskiy *In its* Moscow. Aviation Inst. 2 Jun. 1967 p 129–140 refs (See N68-15251 06-08)

In the present work the application of asymptotic methods has made it possible to obtain the second approximation of solution of the obtained equation, the character of nonlinearity of which differs from all those considered earlier and corresponds to the application of a capacitance p-n of junction. Furthermore, transients in cell are investigated, knowledge of which is necessary for solving the question of high-speed operation of computers or logic machines built around parametrons. Form and duration of transients occurring in the parametron, in distinction from those of the usual self-excited oscillator, depends not only on amplitude but also on phase of oscillations in the circuit at the initial moment (when pumping is switching on). Under certain initial conditions amplitude of oscillations in circuit can first decrease, and then increase. Duration of transients is determined not only by the initial conditions, but also by the Q-factor of circuit and the amplitude of pumping. Under certain non-zero initial conditions it may attain any value (under ideal consideration). The process of build-up of amplitude and phase of oscillations has an oscillatory character. Under certain condition three steady-states can exist in the parametron: absence of oscillations and oscillation with two possible phase states.
Author

N68-15278 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW. UNIVERSITY. HERALD. SERIES 1. MATHEMATICS, MECHANICS
11 Apr. 1967 133 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), v. 19, no. 3, 1964 p 1–96
(FTD-MT-64-559; AD-662466)

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1. ON THE HARNACH INEQUALITY FOR SOLUTIONS OF ELLIPTIC DIFFERENTIAL EQUATIONS OF THE SECOND ORDER S. N. Kruzhkov and L. P. Kuptsov p 3–14 refs (See N68-15277 06-19)

2. ON THE UNIQUENESS OF THE EXPANSION IN A TRIGONOMETRIC SERIES FOR METHODS OF SUMMATION M. I. Livshits p 15–26 refs (See N68-15278 06-19)

3. ON A UNIQUENESS THEOREM IN THE THEORY OF HYPERBOLIC QUASI-LINEAR EQUATIONS N. N. Kuznetsov and Chung-tao Chi p 27–34 refs (See N68-15279 06-19)

4. ABOUT DIRECT POWERS OF UNARY ALGEBRAS O. A. Ivanova p 35–43 ref (See N68-15280 06-19)

5. THE DERIVATION OF MODELS OF LIQUID MEDIA AND SOLID BODIES FROM THE KINETIC EQUATION OF THE AVERAGED FORCE FIELD M. R. Korotkina p 47–59 refs (See N68-15281 06-23)

6. ON THE STABILITY OF FLOW OF A VISCOPLASTIC MEDIUM BETWEEN PLANES WITH A SLOT G. P. Prikazchikov p 60–64 refs (See N68-15282 06-32)

7. ON THE ASYMPTOTIC THEORY OF RELAXATION OSCILLATIONS IN SYSTEMS WITH ONE DEGREE OF FREEDOM N. Kh. Rozov p 65–74 refs (See N68-15283 06-23)

8. THE MOTION OF A SLENDER BODY IN A LIQUID OF VARIABLE DEPTH V. A. Yeroshin p 75–79 refs (See N68-15284 06-12)

9. ABOUT A CASE OF STABILITY OF TRANSIENT MOTION OF A TOP ON A PLANE V. M. Morozov p 81–86 refs (See N68-15285 06-23)

10. CONTROL SYSTEM WITH DOUBLING ACTUATING ELEMENTS WITH DRY FRICTION I. T. Borisenok p 87–99 refs (See N68-15286 06-10)

N68-15286 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONTROL SYSTEM WITH DOUBLING ACTUATING ELEMENTS WITH DRY FRICTION
I. T. Borisenok *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 87–99 refs (See N68-15276 06-10)
(JPRS-28072)

The stable oscillations and conditions for their existence are studied in an automatic control system with correcting or noncorrecting doubling actuating elements. The influence of dry friction and inertia of the actuating elements are taken into consideration.
Author

N68-15434# Air Force Systems Commands, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF ANALOG COMPUTERS FOR ITERATIVE PROCESS OF DETERMINING CONTROL IN ONE OPTIMAL SYSTEM [O PRIMENENII ANALOGOVYKH VYCHISLITEL' NYKH MASHIN DLYA ITERATSIONNOGO PROTSESSA OPREDELENIYA UPRAVLENIYA V ODNOY OPTIMAL'NOY SISTEME]
V. V. Aleksandrov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 71–76 refs (See N68-15426 06-19)

A system of linear differential equations is given to describe a system of automatic adjustment. The system is changed in such a way that from any nonzero initial position it reaches the origin of the coordinates of phase space. Pontryagin's maximum principle is applied to determine the optimal control of a linear automatic system. An iterative method, for use on an analog computer, is used for the solution.
Author

N68-15539# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
TEXAS BIANNUAL OF ELECTRONICS RESEARCH Final Report, Part 2
C. L. Coates, ed. 15 Nov. 1967 257 p refs *Its* No. 6
(Grant AF-AFOSR-766-67)
(AFOSR-67-2342; AD-662359)

CONTENTS:

1. BIOMEDICAL ELECTRONICS p 1–16 refs (See N68-15540 06-05)

2. INFORMATION SCIENCES p 18–90 refs (See N68-15541 06-07)

3. PHYSICAL, QUANTUM, AND PLASMA ELECTRONICS p 91–203 refs (See N68-15542 06-10)

4. SPACE, ATMOSPHERIC, AND EARTH RADIO SCIENCES p 204–214 refs (See N68-15543 06-13)

N68-15542# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
PHYSICAL, QUANTUM, AND PLASMA ELECTRONICS
In its Tex. Biann. of Electron. Res. 15 Nov. 1967 p 91–203 refs (See N68-15539 06-10)
(Grants NsG-353; NGR-44-012-043; Contracts F08635-67-C-0046; DA-44-009-AMC-1405(T); Grant NSF GK-1395)

The photodielectric effect utilized in a new optical detector was observed at 4.2°K in GaAs, Ge, InAs, InSb, and Si; and thin films were studied for possible digital device applications. Holography, microholography, and polarization holography research is summarized; and an adaptation of holographic interferometry is reported that obtains effective infinite-fringe Mach–Zender interferograms with a noncritical system. Other studies deal with ion–electron resonance, power transfer near the lower hybrid resonance, recombination in disintegrating plasmas, fluctuations and anomalous diffusion in radio frequency plasmas, and ion cyclotron resonance. Laser-induced breakdown in superhigh pressure InSb far infrared detectors is reported, as are studies on plasma production and injection with coaxial and conical guns. M.W.R.

N68-15576 Joint Publications Research Service, Washington, D. C.
TECHNICAL CYBERNETICS, NUMBER 5, 1967
23 Jan. 1968 320 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Tekhn. Kibernetika. (Moscow), no. 5, Sep.–Oct. 1967 p 1–208
(JPRS-44114)

Papers are presented in the following areas of cybernetics: control problems and operations; queing systems and reliability; automata; and automatic control. For individual titles, see N68-15577 to N68-15596.

N68-15577 Joint Publications Research Service, Washington, D. C.
CYBERNETICS AND TECHNICAL PROGRESS
B. W. Petrov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 1–14 ref (See N68-15576 06-10)

The basic problems of technical cybernetics are discussed and their application to automatic operations with participation of people are outlined. Cybernetics are developed from the automatic monitoring and control theory, the theory of relay circuits and finite automata, and mathematical techniques for programming, games, statistics, queueing, etc. G.G.

N68-15578 Joint Publications Research Service, Washington, D. C.
THE THEORY OF OPTIMAL CONTROL SYSTEMS
N. N. Krasovskiy and N. N. Moiseyev *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 15–32 (See N68-15576 06-10)

The application of optimal control principles to dynamic systems which may be described by ordinary differential equations is evaluated. Problems of programmed control, where the initial state of the object is given and where the control effect is found in a time function, and of systems synthesis with feedback and control minimization are discussed. The principle of the maximum and the method of classical variation calculus are suitable for the solution of problems of programmed optimal control. G.G.

N68-15579 Joint Publications Research Service, Washington, D. C.
SYNTHESIS OF LINEAR FORECASTING SYSTEMS WITH RESPECT TO COMPLEX STATISTICAL QUALITY CRITERIA
D. B. Yudin *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 33–49 refs (See N68-15576 06-10)

This article is devoted to optimization of the structure of linear forecasting systems for cases where the control quality index is practically an arbitrary continuous function of the first and second moments of distribution of the errors in extrapolation. It has been shown that the solution of the corresponding variation problems reduces to investigation of essentially simpler variation problems and an extremal problem. The means of realization of the prognosis schemes in accord with the complex quality criteria are pointed out. One of the recommended methods of constructing the optimal prognosis mechanism is connected with using the known schemes for the solution of simpler problems and a random mechanism with statistical disperion characteristics calculated in advance (according to the prognosis quality index). Author

N68-15581 Joint Publications Research Service, Washington, D. C.
THE FOKKER–PLANCK–KOLMOGOROV EQUATION AND SYNTHESIS OF RELAY CONTROL SYSTEMS
A. A. Krasovskiy *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 69–81 refs (See N68-15576 06-10)

Dynamic Systems are investigated with random initial deviations. The system is considered optimal if for the given restrictions the probability density in the transient process on the periphery of the phase space decreases with maximum intensity, and it increases in the center with greatest intensity. On the basis of this condition by analysis of the Fokker–Planck–Kolmogorov equation written for the logarithmic probability density, the general form of the conditionally optimal relay controls is defined. It is demonstrated that for the special case of control of the velocity of a phase point the solution of the problem of synthesis of conditionally optimal equations may be carried to the end, that is, the coefficients of these equations are defined. Author

N68-15583 Joint Publications Research Service, Washington, D. C.
RECURRENT SELF-TRAINING ALGORITHMS
Ya. Z. Tsypkin and G. K. Kel'mans *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 103–117 refs (See N68-15576 06-10)

The general approach to the solution of self-training problems connected with minimization of the criterion of accuracy of classification on the basis of the method of stochastic approximation is discussed. For the classification accuracy criterion of the type of the average risk general self-training algorithms are obtained. It is shown that the known self-training algorithms are special cases of these algorithms. Some applications of general self-training algorithms are investigated. Author

N68-15590 Joint Publications Research Service, Washington, D. C.
GEOMETRIC PATTERN RECOGNITION ALGORITHM
I. B. Sirodzha *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 184–199 refs (See N68-15576 06-10)

The approximation algorithm for geometric pattern (figure) recognition of a certain class in a plane is investigated independently of the position, orientation and scale of the objects of recognition. The basis for synthesis of the algorithm is the possibility for analytical description of the complex geometric forms with the help of R-functions introduced by V. L. Rvachev. The algorithm may be used for machine recognition of outlines given by the cartesian coordinate information. Results are presented from experiments in recognition of typed and handwritten symbols with simulation of the proposed algorithm on the Ural-2 digital computer. Author

N68-15591 Joint Publications Research Service, Washington, D. C.
SIMPLE LOGICAL NEURON SYSTEMS AND AN EXAMPLE OF A CLASSIFIER
D. I. Kirvelis and N. V. Pozin *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 200–208 refs (See N68-15576 06-10)

Some simple logical systems are investigated for continuous variables from elements which are model representations of an analog neuron. Rules are presented together with an example of the construction of a classifier which analyzes the complex combination of many continuous input signals with respect to their mutual relationships expressed in the concepts of "greater than," "less than," and "equal." Author

N68-15592 Joint Publications Research Service, Washington, D. C.
SELF-ADJUSTING SYSTEMS IN AUTOMATIC CONTROL
V. Yu. Rutkovskiy *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 209–226 refs (See N68-15576 06-10)

One of the possible classifications of self-adjusting systems is presented; a brief survey of the search and searchless self-adjusting systems is presented and certain areas are indicated for further development of self-adjusting systems. Author

N68-15593 Joint Publications Research Service, Washington, D. C.
SYNTHESIS AND ANALYSIS OF NONLINEAR AUTOMATIC SYSTEMS BY THE METHOD OF MOTION DIVISION
Ye. I. Gerashchenko *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 227–250 refs (See N68-15576 06-10)

Phase space methods permit the investigation of nonlinear control laws; elimination of the low order of the analyzed system offers the possibility to investigate complex nonlinear control systems taking the nonlinearity of the object into account. This motion division method is based on the separation of the "fast" and "slow" components in the total motion of the system. Thus, the separation of motion components of a complex system by speed is successful in discontinuous oscillations theory, for harmonic linearization methods, etc. G.G.

N68-15594 Joint Publications Research Service, Washington, D. C.
SEPARATION OF A CONTROLLABLE PROCESS WITH RESPECT TO FREQUENCIES DURING APPROXIMATE INVESTIGATION OF NONLINEAR SYSTEMS
Ye. P. Popov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1967 p 251–264 refs (See N68-15576 06-10)

The control processes in some automatic systems are a complex set of fast and slow components in time. In nonlinear systems they have more complex interrelationships than in linear systems. In the given work a method is presented for operation of a controllable process with respect to frequencies taking into account the nonlinear interrelationships on the basis of the method of harmonic linearization. Author

N68-15595 Joint Publications Research Service, Washington, D. C.
SPECIAL FEATURES OF BEHAVIOR OF CONTROL SYSTEMS WITH SHARPLY DIFFERENT RATES OF THE MOTION COMPONENTS
B. V. Viktorov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 264–273 refs (See N68-15576 06-10)

Some special features of the dynamic problems of automatic control described by systems of ordinary differential equations containing a small parameter with derivatives are investigated. The difference in the statement from the known works, in particular, [1], in addition to the technical area consists in the fact that the righthand sides of the systems of equations are also assumed to be functions of the same parameter where they undergo a discontinuity for its zero value. The investigated problems are encountered in practice, for example, when formulating the control law for complex systems. Author

N68-15596 Joint Publications Research Service, Washington, D. C.
THE PROBLEM OF SYNTHESIS OF AUTONOMIC CONTROLS
T. A. Letova *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 274–293 refs (See N68-15576 06-10)

The solution is given to the problem of synthesis of optimal autonomic controls in the case where the number of control mechanisms m is equal to the number of controlled coordinates n. However, for a number of practical problems $m<n$. In the given article the method of solution of the problem of being autonomous is developed for the case where $m<n$. Author

N68-15625# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
HIGH-SPEED EXTREMUM REGULATOR WORKING PER METHOD OF RANDOM SEARCH [BYSTRODEYSTVUYUSHCHIY EKSTREMAL'NYY REGULYATOR, RABOTAYUSHCHIY PO METODU SLUCHAYNOG POISKA]
L. A. Rastrigin and L. V. Sytenko 14 Jul. 1967 28 p refs Transl. into ENGLISH from Tr. Inst. Elektron. i Vychislitel'noy Tekhn. (USSR), v. 5, no. 6, 1963 p 237–255
(FTD-MT-24-94-67; AD-662575)

An extremal self-adaptive digital regulator for the optimization of objects with many parameters is described. The main part of the regulator is a generator of random pulse sequences, and the optimal mode is determined by random search; this is shown to afford a faster degree of convergence in the adjustment of many-parameter objects than other methods (e.g., the gradient method) and to result in an operating speed two orders of magnitude higher than hitherto developed systems. The extremal regulator is of the learning type, in that parameter changes which lead to improved quality have a greater probability of occurence. The main units of the regulator (random-sequence pulse generator, sequence to amplitude converter (modifier), model of the object, logic block, memory block, limiters) are described in detail, and the results of an experimental check on the operation of the regulator are reported. The adjustment speed increases with increasing size of the discrete steps used in the variation of the parameter and memory. The adjustment accuracy increases with the memory step and decreases with an increasing parameter step. Compensation for null drift and for industrial pickup noise is provided. TAB

N68-15689# Te Co., Santa Barbara, Calif.
FIVE COLOR SEPARATION INVESTIGATION Final Technical Report, Dec. 1966–Sep. 1967
Charles R. Lisrley and Clyde W. Harris Nov. 1967 69 p refs
(Contract DAAK02-67-C-0172)
(FTR-6031; AD-662725)

The purpose of the program was to determine the feasibility of extracting wanted single colors from multicolor maps. Unlike conventional three color graphic arts methods of color extraction, the approach utilized from four to twenty color sample analysis and analog and digital processing of the color data. The object map was line scanned, the resultant optical signal separated into color channels that in turn were converted to electronic signals and these signals processed to produce a yes-no output recreating the wanted color line scanned on film. Both color matrix optimization and multilevel logic electronic processing functions were evaluated.

The results showed that color matrix optimization was not completely effective. The multilevel logic function, however, produced excellent results for several sample map sections tested. These maps included variations in print color, color overprinting, variations in substrate paper, and a wide variety of print geometries. The overlay of the resultant color extractions produced a faithful rendition of the original map, with the slight exception that fine detail such as halftone printing tended to be enhanced. Setup time to establish the logic extraction parameters for a given map was about 15 minutes for each color. Author (TAB)

N68-15874# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN ALGORITHM OF RECOGNITION SYSTEMS OF THE PERCEPTRON TYPE WITH A CORRELATOR AT THE INPUT [ALHORYTM ROZPIZNAYUOI SYSTEMY PERTSEPTRON-NOHOTYPU Z KORELYATOROM NA VKHODI]
V. I. Vasyl'yev, O. H. Ivakhnenko, A. G. Ivakhnenko, H. O. Lemishevs'kyy, and G. A. Lemisheyskiy 25 Jul. 1967 25 p refs Transl. into ENGLISH from Avtomatyka (Kiev), no. 1, 1966 p 7–21
(FTD-HT-23-582-67; AD-662587)

The paper deals with a recognition system, consisting of a correlator and perceptron, designed for recognition of patterns on a uniformly illuminated background. To reduce the size of the recognition system, a two-dimensional autocorrelation function is employed as the input description. This function is invariant to some isomorphous transformations. A new autocorrelation function, obtained by positive and negative images, is proposed, which permits the reduction of the dimensions of the apparatus. The algorithm for calculating the autocorrelation function is adapted for digital computers. An analog television variation of the autocorrelator is also described. The perception part of the system (choice of properties, mask-random prototypes, etc.) is calculated. TAB

N68-16090# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
DETERMINATION OF LINEAR DISCRIMINANT FUNCTIONS Interim Technical Report
Arthur R. Butz Nov. 1967 32 p refs
(Contract N00014-67-A-0356-0003; Grant NSF GK-1540)
(TR-67-116; AD-663171)

The problem of determining a linear discriminant function for approximately separating two sets of points in a space E superscript m is treated. The two sets of points are assumed not linearly separable; hence only an approximation is possible. TAB

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N68-15022# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
THE MULTI-RECOMPRESSION HEATER, A NEW CONCEPT FOR LARGE SCALE HYPERSONIC TESTING
Roger C. Weatherston 1967 61 p refs
(CAL-AD-2390-Z-1)

The thermodynamic, heat transfer, and mechanical design aspects of a proposed multi-recompression heater with a potential of attaining 7000°K at 300 atm and 8000°K at 50 atm are discussed. The heater which converts shaft power directly into thermal energy is to be used for simulation testing of high performance reentry space vehicles and missiles. Basic operational, heater–nozzle compatibility, energy and recirculation, and leakage loss equations are presented in the thermodynamic analysis. Consideration of heat transfer includes radiation and convection heat transfer, along with cooling of the supersonic expansion nozzle. Sizing and performance capability of the multi-recompression heater is assessed, and a proposed program for developing a prototype model to realistically demonstrate the multi-recompression concept is presented. B.S.D.

N68-15152# United Kingdom Atomic Energy Authority, Harwell (England). Analytical Sciences Div.
APPLICATION OF A SEALED-TUBE NEUTRON GENERATOR TO THE DETERMINATION OF COPPER AND SILICON IN ALUMINIUM ALLOYS
T. B. Pierce, J. W. Edwards, and D. Mapper Oct. 1967 12 p refs
(AERE-R-5616) HMSO: 1s 9d

A neutron generator installation is described which employs a sealed-tube as source of neutrons. The generator has been used to determine copper and silicon in aluminum base alloys at levels of >1% and >0.3% respectively; irradiation, cooling and counting took a total of 3 minutes. Author

N68-15220# Institut Franco-Allemand de Recherches, St. Louis (France).
EXPERIMENTAL STUDY OF A SWEPT-BACK PROJECTILE [ETUDE EXPERIMENTALE D'UN PROJECTILE DU TYPE FLECHE]
M. Giraud 21 Jul. 1967 40 p refs In FRENCH
(Contract DTAT-896.009/70)
(ISL-T-26/67)

Development and construction of a four-part thrust ring for firing projectiles at 1000 m/s velocity in a 30 mm caliber smooth barrel is described. Comparison between molded and machine formed thrust rings established the latter as the better propelling device. Author

N68-15222# Institut Franco-Allemand de Recherches, St. Louis (France).
DETERMINATION OF DYNAMIC TENSION-ELONGATION CURVES DURING PERCUSSIVE TRACTION AND COMPRESSION [ERMITTLUNG DYNAMISCHER SPANNUNGS-DEHNUNGS-KURVEN BEI STOSSARTIGEN ZUG UND DRUCK-BELASTUNGEN]
H. Nebel 20 Feb. 1967 38 p refs In GERMAN
(ISL-T-8/67)

Described is the development and construction of a hydraulic apparatus that tests the shearing-breaking strengths of materials at rapidly applied constant pulling and pressure stress loads and at the same time registers time-elongation and plastic deformation. Preliminary stress results on ZICRAL show a brief 15% higher shearing stress at the median elongation velocity of $\epsilon > 70(s^{-1})$ than at a static test. Transl. by G.G.

N68-15273# Technische Hochschule Hannover (West Germany).
ON THE INFLUENCE OF PROFILE CHANGES BY CORROSION, EROSION AND FOULING ON THE MECHANICAL EFFICIENCY OF BLAST FURNACE TURBINE FACILITIES [UEBER DEN EINFLUSS DER PROFILVERAENDERUNGEN DURCH KORROSION, EROSION UND VERSCHMUTZUNG AUF DEN WIRKUNGSGRAD VON GICHTGASTURBINEN-ANLAGEN]

Horst Sonnenschein (Ph.D. Thesis) 1966 110 p refs In GERMAN

Corrosion effects of air and flue dust, and of dirt layers, on the efficiency of turbine blades were studied by evaluating the proficiency of changed blade profiles. Correlations between interior turbine efficiency and suction ability to profile changes, and between system efficiency and turbine blade profile changes were analyzed for several exit angles of a characteristic four step turbine blade cascade. Results found definite relationships between profile increase and friction losses at which combustion chamber pressure leveled off, and turbine exit temperature increased sharply. Corrosion of the first part of the blade cascade system degraded performance much more than dust layer on the whole system. Transl. by G.G.

N68-15328# Naval Ordnance Lab., White Oak, Md. Air/Ground Explosions Div.

EVALUATION OF A SMALL CONICAL SHOCK TUBE FOR PROJECT PAPOOSE

James F. Proctor 18 Sep. 1967 46 p refs Sponsored by DASA (NOLTR-67-85; AD-662032)

A small conical shock tube was designed for a simple, inexpensive experiment to determine the sufficiency of simulating only ambient pressure in laboratory investigations of high-altitude explosions. Pressure waves formed by the detonation of an equivalent 0.7-gm pentolite charge were monitored by the response of mechanical foil gages. The cone could be tested in a laboratory high-altitude simulation chamber, and the identical experiment could be taken aloft by rocket and tested at altitudes. Evaluation tests on the cone indicated an asymmetric shock wave that led to non-reproducible foil gage response. Test results are given and discussed, and alternative methods for problem solution are recommended. Author (TAB)

N68-15344# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

PERFORMANCE ANALYSIS OF UTIAS IMPLOSION-DRIVEN HYPERVELOCITY LAUNCHER

P. A. L. Sevray Jan. 1968 82 p refs
(Contract AF 33(615)-5313)
(UTIAS-TN-121)

A performance analysis of an implosion-driven hypervelocity launcher is presented which is based on a numerical code using the artificial viscosity technique. The numerical calculations are inviscid as no losses are taken into account and the analytical results yield performances that are at least 50 percent greater than the available experimental data. From the results obtained numerically, detailed wave-diagrams of the processes in the launcher are given. The launching conditions at the base of the projectile are emphasized. An optimization study of the existing launcher (8 in. dia.) hemispherical implosion chamber and several barrel sizes has also been made followed by an analysis of what should be the optimum parameters of a second generation launcher that is able to launch one-inch diameter projectiles to hypervelocities. In order to make this calculation more realistic, a number of points should be studied and these are outlined in the conclusion. Author

N68-15569# California Univ., Berkeley. Hydraulic Engineering Lab.

OCEAN WAVE SIMULATION FOR ENGINEERING DESIGN

Leon Emry Borgman Oct. 1967 46 p refs
(Contract DA-49-055-CIV-ENG-64-4)
(HEL-9-13; AD-662178)

Techniques for simulating ocean waves are most applicable when the response of the structure is complicated and perhaps involves other random environmental factors that may be introduced by concurrent simulations. The accuracy of the wave simulation is greatest for low amplitude waves and decreases for large steep waves. The degree of loss in accuracy for the higher and steeper waves deserves further research. Simulation techniques have the disadvantage of being time consuming and usually requiring the use of computers. Analytic solutions are to be preferred if feasible. Sometimes part of a problem can be solved analytically and then the intractable parts processed by simulation. A detailed search for shortcuts and approximations before proceeding with the actual simulation will often result in sizeable savings of computer time. The engineer will usually be forced to simulate with one-dimensional spectral densities because there are so few reliably measured two-dimensional spectral densities. The formulas for 2-D spectra were included in the hope that satisfactory directional data will soon be available. The linearization of the drag force, or its approximation by polynomials, is particularly useful in many problems. Author (TAB)

N68-15620*# Data Dynamics, Inc., Los Angeles, Calif.

THE REASONS FOR THE TRAGEDY AT THE CAPE KENNEDY COSMODROME

1967 5 p Transl. into ENGLISH from Krasnaya Zvezda (Moscow), 4 Feb. 1967 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92573) CFSTI: HC $3.00/MF $0.65 CSCL 22D

A journalistic account of the Apollo tragedy in January 1967 is given. The pure oxygen atmosphere and the several casulties incurred with its use are discussed. The troubles arising earlier in the program are reviewed, and the investigations into the accident are mentioned. N.E.N.

N68-15730# National Physical Lab., Teddington (England). Aerodynamics Div.

DEVELOPMENT AND CALIBRATION OF LOW SPEED DEMONSTRATION WIND TUNNEL

P. V. Gales 24 May 1967 32 p refs Prepared for Min. of Technol.
(NPL-AERO-Note-1058; ARC-29130) CFSTI: HC $3.00/MF $0.65

A description is given of the design and calibration of an open-circuit tunnel with an 8 in × 5 in (20.3 cm×12.7 cm) working section and a maximum speed of 135 ft/sec (41.2 m/sec.). The steps taken to locate and eliminate a source of flow unsteadiness are outlined. The design of a number of similar tunnels in colleges of technology is also reviewed. Author (ESRO)

N68-15777*# Physics International Co., San Leandro, Calif.

EXPLOSIVE HYPERVELOCITY LAUNCHERS

E. T. Moore, Jr. Washington NASA Feb. 1968 74 p refs
(Contract NAS2-3577)
(NASA-CR-982; PIFR-051) CFSTI: HC $3.00/MF $0.65 CSCL 14B

This report summarizes the analytical and experimental effort that demonstrates the feasibility of using a two-stage explosively driven light gas gun to obtain high projectile velocities. The second stage of this gun consists of an explosive lensing system that is used to produce an implosively formed piston whose velocity can be increased uniformly. The uniformly accelerated piston is shown to generate a nearly constant base pressure for projectile accelerations. Velocities as high as 12.2 km/sec have been obtained for a 0.17-gram magnesium–lithium projectile. Author

N68-15788# California Univ., Berkeley. Inst. of Transportation and Traffic Engineering.

PHOTOMETER DETECTION CONTRAST AND VISIBILITY OF RUNWAY LIGHTING IN DENSE FOG Final Report

D. M. Finch, R. Horonjeff, and H. G. Paula Jun. 1967 66 p refs
(Contract FAA-ARDS-434)
(SRDS-RD-67-33; AD-662279)

Using a specially developed photometric method, the visibility of a runway lighting system was studied under various conditions of visual range and background brightness. The method is based on measurement of a defined quantity, C sub d, called photometer detection contrast, and depends on the correlation of this quantity with subjective visibility. All tests were performed in the FAA Fog Chamber at 1/10 scale. Photometric data for the runway lights were obtained in daytime and nighttime visual ranges of 1200, 900, and 700 ft, and maximum visibility distances for various portions of the lighting system were then determined on the basis of an assumed value of .06 for the minimum usable C sub d. Based on the number of lighting elements that would be visible to a pilot under the various test conditions studied, it was concluded that the lighting system would become but marginally effective for visual guidance in a daytime fog of 900-ft visual range and background brightness of about 50-600 fL. The same would hold true for a nighttime fog of 700-ft visual range. In a daytime visual range of 700 ft, the system would no longer provide effective visual guidance. Author (TAB)

N68-15858*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
VISUAL SIMULATION FACILITY FOR EVALUATION OF LUNAR SURFACE ROVING VEHICLES
F. L. Vinz, M. H. Knighton, H. F. Lahser, L. G. Thomas, J. T. Howell, et al Washington Feb. 1968 41 p refs
(NASA-TN-D-4276) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A fixed base visual simulator was developed to serve primarily as an engineering tool which would include man–machine interaction in evaluations of preliminary Lunar Surface Vehicle design. Visual cues are obtained by means of a visual simulator consisting of a camera and model unit and a projector and screen providing a 30°×50° field-of-view of a three-dimensional terrain model. The crew station consists of a general-purpose two-man cockpit designed for maximum flexibility. The crew station and the general-purpose analog computers are interconnected through an interface console featuring a removable patch panel and containing power supplies, relay racks, servo panels, limiters, and other items common to most simulators. The terrain model is scaled 150:1 and has a maximum dimension of 12×27 feet. Maximum camera-model separation is eight inches. Lunar surface details required in the manufacture of the model were reduced from Ranger VIII photographs and supplied by the Branch of Astro-Geology. Terrain surface irregularities are detected by sensors mounted around the camera optics. Author

N68-15994*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
CLEAN ROOM FACILITIES FOR ASSEMBLY, EXPLORER 35 SPACECRAFT
Francis N. Le Doux Dec. 1967 23 p Presented at the Am. Soc. of Tool and Manufacturing Engr. Assembly Seminar, Chicago, 6–7 Feb. 1968
(NASA-TM-X-63078; X-723-67-628) CFSTI: HC $3.00/MF $0.65 CSCL 14B

In order to reduce particulate and biological contamination of the Explorer XXXV spacecraft, clean-room facilities of various classes were used to conduct a specific task. Debris generating operations were performed in uncontrolled areas with protection afforded to flight hardware in the near vicinity of debris generation. Decontamination, conformal coating, and encapsulation of electronics were performed in a class 10,000 conventional clean-room. Spacecraft build-up and some engineering tests were conducted in a class 100,000 conventional clean-room. Electronic systems check-out in the field, cleaning and decontamination of small hand tools, instrument assembly, and/or functional operation tests, final spacecraft decontamination and assembly, and biosssying were conducted in a class 100 bio-clean room environment. All clean-room areas were restricted to number of personnel working in area, clean-room dress, deportment, and procedures. On the basis of the bio-records it was determined that the surfaces of the Explorer XXXV spacecraft contained not in excess of 9×10^5 microorganisms prior to decontamination. This low level of contamination has been attributed to the assembly, test, and integration of the spacecraft in the various clean-room environments and the contamination controls utilized. Author

N68-16018*# Naval Ordnance Test Station, China Lake, Calif.
OPERATION MANUAL FOR THE NOTS–NASA ROCKET MOTOR ACOUSTIC TEST FACILITY STEADY-STATE RESONANCE TESTS WITH FLOW
F. G. Buffum, P. H. Werbeck, and D. R. Skaar Jun. 1967 36 p refs Supported in part by NASA
(NASA-CR-91670; NOTS-TP-4304; AD-662218) CFSTI: HC $3.00/MF $0.65 CSCL 14B

Steady-state resonance tests with through flow and a sonic nozzle throat condition were run on the NOTS-NASA acoustic-loss test facility to establish and record the instrument hookup schematics, instrument settings, system calibration procedures, and data reduction techniques. The report is intended as a manual for operating the facility for this type of test. With this knowledge, the facility may be used to measure experimentally the acoustic chamber losses of scale-model rocket chambers. The loss coefficients that are determined may be used in comparing various internal motor geometries before full-scale motors are built and tested, with a possible saving of time and money. Author (TAB)

N68-16034 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF CHANGE OF PRESSURE ALONG LENGTH AND ENDS OF THE EIFFEL CHAMBER OF THE SUPERSONIC WIND TUNNEL [ISSLEDOVANIYE IZMENENIYA DAVLENIYA PO DLINE I TORTSAM KAMERY EYFELYA SVERKHZVUKOVOY AERODINAMICHESKOY TRUBY]
B. A. Balanin *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 97–101 ref (See N68-16026 06-23)

The results of an experimental investigation of the pressure distribution on the walls of the Eiffel chamber of a supersonic wind tunnel are presented. An attempt is made to justify the assumption, generally made, that the pressure along a supersonic free stream is constant inside the chamber. Analysis of the experimental data shows that: (1) the pressure on the bottom and side walls is constant at all regimes (ejection and throttling) and its value depends on the total pressure, the Mach number, and the geometrical parameters of the chamber; (2) the end-face pressure along the radius varies in a complex way in the throttling regime, passing through a minimum and reaching a maximum at the edge of the nozzle. Author

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N68-15086# Yale Univ., New Haven, Conn.
LOCALLY MAXWELLIAN DISTRIBUTIONS IN A RELATIVISTIC GAS
Don Kelly [1967] 20 p refs
(Contract Nonr-609(51))
(AD-662906)

The possible types of locally Maxwellian distributions are determined for a relativistic gas. In the absence of external forces the number of free parameters is eleven, a reduction by two from the number obtained for the nonrelativistic case. The close correspondence of the relativistic and nonrelativistic solutions reveals which two parameters must be zero. Severe restrictions also are placed on the possible types of forces which are consistent with local equilibrium and the requirements of special relativity. Special attention is directed to the local equilibria open to a gas of charged particles subject to an electromagnetic field. An explicit solution is obtained for the distribution function of such a gas when the fields are constant. Author (TAB)

N68-15110# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EFFECT OF WATER FLOW RATE ON CAVITATION EROSION [VLIYANIYE SKOROSTI POTOKA VODY NA KAVITATSIONNYY IZNOS]
S. P. Kozyrev 27 Jul. 1967 15 p refs Transl. into ENGLISH from Mashinovedeniye (USSR), no. 1, 1966 p 91–95
(FTD-HT-23-581-67; AD-662788)

The dependence of the rate of erosion (I) as a function of the flow rate (v) is expressed by the relationship I = Av to the n power, where A is a power exponent. A table lists a number of theoretically and experimentally determined values of n, given by various authors in the literature. The data was supplemented by experimental data obtained by testing lead samples in a specially constructed hydrodynamic tube (diagram given). The cavitation results were observed with flow around a round shape with a diameter of 8 mm, placed in a rectangular test chamber. The results of these tests are shown in a series of curves. A relationship is established which shows that the value of the exponent, n, is not a constant, but that it varies with the transition from one stage of erosion cavitation to another. Author (TAB)

N68-15122*# Mississippi State Univ., State College. Engineering and Industrial Research Station.
RESEARCH STUDY FOR DETERMINATION OF LIQUID SURFACE PROFILE IN A CRYOGENIC TANK DURING GAS INJECTION Quarterly Progress Report, 18 Sep.–18 Dec. 1967
William D. McCain, Jr., James T. Smith, and Thomas J. Rice 18 Dec. 1967 33 p ref
(Contract NASS-11334)
(NASA-CR-61445; QPR-14) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Correlation equations were developed in the continuing research on a study for determining liquid surface profile in a cryogenic tank during gas injection. The equations allow the prediction of entrainment as a function of time, liquid viscosity, and Reynolds number. The entrainment data are analyzed in terms of the air mass flow rate, liquid viscosity, initial liquid depth, and time duration. It is felt that the system of equations gives reasonable accuracy in the prediction of entrainment data. Tables are presented on the error ranges from use of predicted equations along with graphs of entrainment versus viscosity for various test sections. B.S.D.

N68-15141# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
IMPACT OF A SUPERSONIC JET ON A SURFACE [UDAR SVERKHZVUKOVOY STRUI O POVERKHNOST']
A. Ya. Sagomonyan 27 Jul. 1967 14 p ref Transl. into ENGLISH from Vestn. Mosk. Univ. Ser. i: Mat. i Mekhan. (Moscow), no. 6, 1966 p 98–103
(FTD-HT-23-924-67; AD-662853)

The problem of the impact of a supersonic gas jet on a flat rigid surface is considered. The form and position of a shock wave impinging on a surface, also the average values of gasdynamic parameters of a subsonic flow region between a shock wave and the surface of a body are determined. Expressions for velocity components behind the shock wave are derived for supersonic gas jets. The detachment distances of the shock wave are determined under certain simplifying assumptions for both supersonic and hypersonic jets. The flow between the shock wave and the surface is analyzed, assuming that: (1) the velocity along the x-axis is independent of y and is equal to the values of this component on the shock wave; (2) the velocity along the y-axis depends linearly on y, thus it is equal to the value of the component on the shock front and vanishes on the surface. The analysis yields data on flow configuration, pressure field, and density distribution. The flow parameters in the region of jet expansion on the surface are determined by solving the problem of gas flow of sonic velocity from a gap between two circles of radius R, separated by the distance AA = 2 y sub k. The application of the method described to the problem of a supersonic gas jet impinging on a curvilinear axisymmetric surface is included. TAB

N68-15159# Wisconsin Univ., Madison. Mathematics Research Center.
ON WAVES OF PERMANENT TYPE IN A ROTATING CYLINDRICAL SYSTEM
M. C. Shen Jul. 1967 25 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-757; AD-662743)

Nonlinear long waves in a rotating fluid supported by a cylindrical wall are studied. Periodic waves of permanent, conoidal shape are found near certain critical angular velocities both in the case where the fluid is outside the cylinder and in that where it is inside the cylinder. To exhibit clearly how such waves depend on the rotation and surface curvature, the analysis concentrates on the case of a homogeneous incompressible fluid with a free surface. Author (TAB)

N68-15198# Aeronautical Research Council (Gt. Brit.).
SOME INVESTIGATIONS INTO THE SPANWISE NON-UNIFORMITY OF NOMINALLY TWO-DIMENSIONAL INCOMPRESSIBLE BOUNDARY LAYERS DOWNSTREAM OF GAUZE SCREENS
B. G. de Bray (Cambridge Univ.) 13 Jul. 1967 29 p refs
(ARC-29271) CFSTI: HC $3.00/MF $0.65

Spanwise boundary layer non-uniformity is investigated at low subsonic speeds for a wide range of conditions. All the experiments were done in a two-dimensional blower tunnel designed for boundary layer research but by the use of vertical and horizontal central flat plates and a central flat splitter extending upstream to the gauzes the following variations were investigated in addition to changing the open-area ratio and number of screens and the type of honeycomb: a) Flow contraction in the plane of the test surface, by comparing vertical and horizontal flat plates. b) Surface curvature of the contraction wall, by comparing rear wall with splitter. c) Continuity of surface from screen, by comparing flat plate in test section with splitter. d) Distance of measurement plane from screens along direction of flow. It will be seen that spanwise non-uniformities, dependent upon the arrangement of screens and honeycomb, were found with all these arrangements. The implication is that non-uniformities in the air-flow outside the boundary layer, produced by the screens, persist into the test section and cause irregularities of the boundary layer in any object placed in it. Further, the close similarity in the pattern of boundary

layer nonuniformity found by taking traverses at various distances in the flow direction along a tunnel wall, for example, suggests the possibility that such variations are related to a persistent pattern in the free stream. Author (ESRO)

N68-15217# Institut Franco-Allemand de Recherches, St. Louis (France).
REFRACTION OF AERIAL SHOCK WAVES. PART 3: THE CASE OF A SHOCK WAVE OF CONSTANT INTENSITY REFRACTED IN A HEAVY ATMOSPHERE WITH OR WITHOUT VERTICAL TEMPERATURE GRADIENT [REFRACTION DES ONDES DE CHOC AERIENNES. 3E PARTIE: CAS D'UNE ONDE DE CHOC D'INTENSITE CONSTANTE SE REFRACTANT DANS UNE ATMOSPHERE PESANTE AVEC OU SANS GRADIENT VERTICAL DE TEMPERATURE]
C. Thery and A. Peter 30 Dec. 1966 41 p In FRENCH
(Contract DTCA-66-90128-00-481-75-86)
(ISL-T-44/66, Pt. 3)

Numerical equations were formed for calculating shock wave refraction in a gravitational medium with vertical temperature gradients, after the shock wave traveled in a level plane at constant intensity. Obtained equations were applied to an isothermal atmosphere and an atmosphere with constant temperature gradients. It was shown that differences existed between refractions caused by gravity, and those caused by temperature gradients. Gravity effects changed the pressure jump of the shock wave proportional to the quadratic root of the localized pressure; temperature effects were relatively weak, except in the vicinity of the critical refraction angle. Author

N68-15274# Case Western Reserve Univ., Cleveland, Ohio.
TIME-DEPENDENT HYPERSONIC VISCOUS INTERACTIONS
Czeslaw M. Rodkiewicz and Eli Reshotko Nov. 1967 111 p refs
(Grant AF-AFOSR-954-65)
(FTAS/TR-67-28; AFOSR-67-2451; AD-662901)

A flat plate in hypersonic flow at zero angle of attack is stepwise accelerated in the direction of the initial flow by a small amount. The relevant non-steady boundary layer equations with their space and time boundary conditions are transformed into a coupled set of partial differential equations. These equations, for the case of zero pressure gradient, are linearized and the numerical solutions obtained for both zero and non-zero heat transfer at the wall for $0 < pi < or = 1$. For each of the cases calculated, the wall shear, heat transfer, and induced weak interaction pressure are obtained. Author (TAB)

N68-15284 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE MOTION OF A SLENDER BODY IN A LIQUID OF VARIABLE DEPTH [DVIZHENIYE TONKOGO TELA V ZHIDKOSTI PEREMENNOY GLUBINY]
V. A. Yeroshin *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 75–79 refs (See N68-15276 06-10)

The author studies the problem of motion of a thin body of revolution in a tank of incompressible fluid whose bottom forms an angle with the free surface. He seeks the solution of Laplace's equation in the form of a potential of a simple layer, and reduces the problem to the motion of a body in a half-space with a free surface. The potential of velocity of perturbed motion of fluid in a tank whose bottom forms an angle with the free surface of $\pi/2n$ is expressed in the form of a sum of 2n potentials. The author investigates the case of penetration of a narrow cone with angle of opening 2θ into a fluid perpendicular to the free surface at a distance h from the plane vertical wall. From his derived formulas he finds the size of the force of resistance, as $h \to \infty$, for penetration of a cone into a half-space with a free surface. Author

N68-15293# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
IMPACT OF A SUPERSONIC JET AGAINST A SURFACE
A. Ya. Sagomonyan 10 Nov. 1967 8 p ref Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekh. (Moscow), no. 6, 1966 p 98–103
(Contract NOw-62-0604-c)
(TG-230-T535; AD-663078)

The shape and location of the shock wave and the value of the mean parameters of subsonic gas movement between the shock wave and the surface are determined on the basis of some approximations. The gas is assumed to be ideal and calorically perfect. Author (TAB)

N68-15315# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Aachen (West Germany). Inst. fuer Theoretische Gasdynamik.
OBLIQUE REACTION WAVES [SCHIEFE REAKTIONS-FRONTEN]
F. Bartlmae Nov. 1967 58 p refs In GERMAN; ENGLISH summary
(DVL-Bericht-684; DLR-FB-67-73)

A detailed study of oblique reaction waves is given. An oblique reaction wave is defined as a zone of finite thickness in the flow field with heat addition or substraction. In the present paper, only heat addition is considered. No assumption is made concerning the nature of the heat addition which may be a chemical reaction, condensation or any other process with heat release. It is important to note that the thickness of the reaction wave is small compared to the other dimensions in the flow field. Reaction wave polars are derived and discussed. Author

N68-15317# National Physical Lab., Teddington (England). Aerodynamics Div.
VELOCITY DISTRIBUTIONS ON ROUND LEADING-EDGES FOR FREE-STREAM MACH NUMBERS BETWEEN ZERO AND UNITY. PART 2 (PRELIMINARY): GENERAL LEADING-EDGE PROFILES
P. G. Wilby 7 Mar. 1967 13 p ref
(NPL-AERO-1053; ARC-28889) CFSTI: HC $3.00/MF $0.65

A rule is presented that relates compressible-flow velocity on a general round leading edge to the incompressible velocity and angular displacement from the stagnation point. The rule is valid for leading edges on airfoils at zero and finite incidence. Author

N68-15329*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
VENTURI SCALING STUDIES ON THERMODYNAMIC EFFECTS OF DEVELOPED CAVITATION OF FREON-114
Royce D. Moore and Robert S. Ruggeri Washington Feb. 1968 30 p refs
(NASA-TN-D-4387) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Well-developed cavitation of Freon-114 (dichlorotetrafluoroethane) was induced on the walls of a venturi in a recirculating hydrodynamic tunnel. The venturi, which had a throat diameter of 0.976 inch (2.48 cm), was a 0.7 scale of one previously tested. The approach velocity was varied from 20 to 50 feet per second (6.1 to 15.2 m/sec) at controlled liquid temperatures from 0° to 86°F (255.4° to 303.2°K). Pressures and temperatures were measured in the cavitated region and compared with the results of the 1.0-scale venturi. For geometrically similar cavities and fixed flow velocity, the measured cavity pressure and temperature depressions below free-stream values of vapor pressure and temperature were nearly the same for both the 0.7- and

1.0-scale venturis. Cavity pressure and temperature depression trends with liquid temperature and velocity were also similar in the 0.7-scale venturi as in the 1.0-scale venturi. A previously derived method for predicting the thermodynamic effects of cavitation is extended to include the effect of scale. Similarity parameters for developed cavitation were evaluated by using the minimum cavity pressure as a reference rather than the free-stream vapor pressure. The cavitation parameter was shown to be nearly the same value for both the 0.7- and 1.0-scaled venturis. Author

N68-15452*# Southwest Research Inst., San Antonio, Tex. Dept. of Mechanical Sciences.

SIMULATED LOW-GRAVITY SLOSHING IN CYLINDRICAL TANKS INCLUDING EFFECTS OF DAMPING AND SMALL LIQUID DEPTH

Franklin T. Dodge and Luis R. Garza 29 Dec. 1967 37 p refs (Contract NAS8-20290)

(NASA-CR-61469; TR-5) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Liquid sloshing in cylindrical tanks is studied under conditions of simulated low gravities. The effects of finite liquid depths and the determination of the smooth wall damping are emphasized. The experimental and theoretical results show that the fluid dynamics are affected by small h/d ratios in much the same way as for normal, large Bond number sloshing. Measurements of the slosh damping indicate that the damping increases as the Bond number decreases, and two correlation equations for the damping factor are proposed. An equivalent mechanical model developed previously is extended to include h/d variations and linear viscous damping. Comparisons of the force response predicted by the model to that measured in the tests verify the model to a high degree of confidence. Author

N68-15457*# General Dynamics/Convair, San Diego, Calif.

BAFFLING OF FLUID SLOSHING IN CYLINDRICAL TANKS Final Report

G. L. Anderson and H. J. Weiss 1 Apr. 1966 67 p refs (Contract NAS8-20191)

(NASA-CR-61434; GD/C-DDE-66-017) CFSTI: HC $3.00/MF $0.65 CSCL 20D

Consideration is given to the irrotational motion of an incompressible, inviscid liquid contained in a partially filled cylindrical tank. On the vertical wall a thin ring is mounted for the purpose of damping the free surface oscillations of the liquid. The tank is subjected to both transverse and rotational harmonic vibrations. In the solution of Laplace's equation for the velocity potential a dual Dini series arises because the boundary conditions in the plane of the annular baffle are of the mixed type. Several forms of the formal solution of the dual series are given which, in every case, lead to an infinite system of linear algebraic equations. From a numerical point of view, many of these systems are plagued with an ill-conditioned coefficient matrix, and, also, it should be pointed out that in certain cases great care must be taken to obtain accurately the elements of these matrices since they are obtained by summing rather slowly convergent infinite series. Some methods of speeding the convergence of these series are discussed. For the numerical solution of the dual series, since the zeros of the transcendental equation $J'_1(x) = 0$ and numerical values of Bessel functions of the first kind of various orders and arguments are needed, special formulas are tabulated and machine language algorithms are referenced. Author

N68-15458# National Physical Lab., Teddington (England). Aerodynamics Div.

THE ANALOG BETWEEN STREAMLINE CURVATURE AND BUOYANCY IN TURBULENT SHEAR FLOW

P. Bradshaw 1 May 1967 18 p refs (NPL-AERO-1231; ARC-29048; FM-3836) CFSTI: HC $3.00/MF $0.65

A formally exact analog is drawn between meteorological parameters, such as the Richardson number, and the parameters describing the effect of streamline curvature on a turbulent flow. Semi-quantitative use of the analogy to apply meteorological data to curved shear layers shows that the effects of curvature on the turbulence are appreciable if the shear layer thickness exceeds roughly 1/300 of the radius of curvature. Author

N68-15486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE EFFECT OF INITIAL TURBULENCE ON THE EFFICIENCY OF DIFFUSER FLOWS [O VLIYANII NACHAL'NOY TURBULENTNOSTI NA EFEKTIVNOST' DIFFUZORNYKH TECHENIY]

V. K. Migay 3 Aug. 1967 12 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 2, 1966 p 116–119

(FTD-HT-23-536-67; AD-662840)

Experiments were conducted to determine the effect of turbulent exchange in the boundary layer on the efficiency of diffusers with large aperture angles. Turbulence was increased by mounting two perforated plates at the diffuser inlet with openings of 5 and 12 mm spaced at intervals of 6 and 13 mm. A reduction in the intensity of flow separation by gratings was observed visually and confirmed by measurements of the velocity fields at the outlet. Vortex generators are proposed for increasing the intensity of turbulent exchange in the boundary layer to improve diffuser efficiency. Tests of ten types of vortex generators showed no considerable improvement in efficiency. TAB

N68-15487# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FLOW AROUND A FLAT BLUNT PLATE UNDER A SMALL ANGLE OF ATTACK WITH A HYPERSONIC GAS STREAM

V. I. Kholyavko 1 May 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. Mashinostr. (Moscow), no. 2, 1964 p 19–23

(FTD-HT-66-606; AD-662792)

Consideration is given to the characteristics of flow around a blunted flat plate, placed at a small angle of attack to a hypersonic stream of non-viscous ideal gas. The principle of plane cross sections is employed and solution of the problem is reduced to integrating one nonlinear differential equation to determine the position of the shock wave. Equations are derived for the pressure on the surface of an arbitrary body with a blunted leading edge and for the motion of the shock wave. These are then narrowed to the case of a flat blunted plate and an approximate solution is derived for small values of the angle of attack and high Mach numbers of the onrushing flow. Dynamic characteristics (lift coefficient, pressure center location) are determined for a flow around the flat, blunted plate at a small angle of attack and for finite values of Mach number. TAB

N68-15489# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.

SUPERSONIC FLOW PAST BODIES OF REVOLUTION WITH ANNULAR RECESSES

M. G. Morozov and Yu. V. Baryshev 31 Oct. 1967 14 p refs Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. 1: Mat. i Mekhan. (Moscow), no. 6, 1966 p 108–113

(Contract NOw-62-0604-c)

(TG-230-T534; AD-663077)

Discussed are experiments on supersonic flow past a cone-cylinder type body with an annular recess of rectangular section for different M and RE numbers, particular attention is devoted to a determination of the ratio of critical length to depth of the recess in order to clarify the best arrangement for sting supports.
Author (TAB)

N68-15490# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLOW IN CHANNELS WITH PERMEABLE WALLS [TECHENIYE V KANALAKH S PRONITSAYEMYMI STENKAMI]
I. S. Kochenov, L. I. Baranova, and V. V. Vasil'yev 2 Jun. 1967 10 p refs Transl. into ENGLISH from Teplo- i Massoperenos. Pervoe Vsesoyuznoe Soveshch. (Minsk), v. 1, 1965 p 131–135
(FTD-HT-66-518; AD-662243)

The pressure change in a channel with porous walls is described by an equation of motion. The pressure gradient is determined not only by the effect of friction at the wall, which is expressed by the second term on the right hand side of the equation, but also by the dynamic effect connected with transfer due to impulses between the main stream and the outflows. Based on this concept, experiments were carried out in a channel with a diameter of 0.013 meters and a length of 0.1 meters. The section consisted of 270 discs with a thickness of 0.00025 meters and gaps (0.0001 meters) between the discs. The outflow from each section was isolated from the other sections and measurements were made of the pressure drop between sections. The experiments were made at rates corresponding to Reynolds numbers from 15,000 to 50,000.
Author (TAB)

N68-15507# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
DRAG COEFFICIENT OF A SLOWLY MOVING SPHERE IN NEAR-CONTINUUM FLOW Technical Report, Apr. 1964–Mar. 1967
Nobunori Oshima 15 Mar. 1967 42 p refs
(Grants NSF GP-2366; NSF GP-5393)
(TR-19)

The calculation of the drag force on a slowly moving sphere in a gas is approached by the continuum theory. The Navier–Stokes and the Burnett equations are examined. The former is inapplicable, and the latter gives impossible results for smaller particles. By an alteration of the Burnett equation, a reasonable prediction is obtained. When the momentum accommodation coefficient is taken as 0.9, the predicted drag is very close to the Millikan empirical formula.
Author

N68-15511# Lehigh Univ., Bethlehem, Pa. Dept. of Physics.
FORCES ON A SMALL SPHERE IN A GASEOUS FIELD WITH WEAK GRADIENTS CALCULATED BY STOKES-FOURIER EQUATIONS Technical Report, Apr. 1964–Mar. 1967
Nobunori Oshima 15 Sep. 1967 37 p refs
(Grants NSF GP-2366; NSF GP-5393)
(TR-20)

The calculation of the force on a small sphere placed in a weak inhomogeneous gaseous field is approached by using the Stokes-Fourier equations and by kinetic consideration of the boundary conditions. The force is characterized by three coefficients, referring to drag, thermal force and pressure gradient force. Although the Stokes-Fourier equations do not give a consistent solution, we can derive reasonable results for the last two coefficients by a mathematical device altering the nature of the boundary conditions at the sphere surface.
Author

N68-15530*# IIT Research Inst., Chicago, Ill.
STABILITY OF SHEAR FLOW WITH DENSITY GRADIENT AND VISCOSITY
Richard L. Baker, Tzvi Rozenman, and Herbert Weinstein Washington NASA Feb. 1968 58 p refs
(Grant NsG-694)
(NASA-CR-958) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The stability of the mixing region between co-flowing streams of different velocity and density has never been adequately investigated, because a general similarity solution for velocity and density profiles has not been available until recently. A solution method for the homogeneous case was extended to the heterogeneous case in an attempt to find a neutral stability curve for the more complex case. The extension was based on a similarity solution obtained by the authors. A branch line of the neutral stability curve was found but curves with non-zero amplification and damping factors fell on the same side of the neutral stability curves.
Author

N68-15571*# IIT Research Inst., Chicago, Ill.
EXPERIMENTAL INVESTIGATION OF THE MIXING OF TWO PARALLEL STREAMS OF DISSIMILAR FLUIDS
Richard L. Baker and Herbert Weinstein Washington NASA Jan. 1968 102 p refs
(Grant NsG-694)
(NASA-CR-957) CFSTI: HC $3.00/MF $0.65 CSCL 20D

In this work, velocity and density profiles for both homogeneous and heterogeneous systems were obtained. The range of density ratios was 1:1 to 7:1. The velocity ratio range was 1:1 to 5:1. Turbulence intensities were also measured for the homogeneous case. The experimental method was based on hot wire anemometry. The data obtained agreed well with the analytical investigations in the literature.
Author

N68-15604# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOTION OF A SOLID PLANE IN VISCOUS LIQUID UNDER THE ACTION OF A LONGITUDINAL ELASTIC FORCE [O DVIZHENII TVERDOY PLOSKOSTI V VYAZKOY ZHIDKOSTI POD DEYSTVIYEM PRODOL'NOY UPRUGOY SILY]
A. B. Ivanov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 39–52 refs (See N68-15601 06-23)

The motion of a solid plane in a viscous liquid from the state of rest under the action of a longitudinal elastic force is treated. In the case of unbounded liquid media the plane passes through the balance position a finite (odd) number of times. If the liquid is bounded by two motionless planes equidistant from the mobile plane, the latter passes through the balance position a finite (odd) number of times, infinite number of times, or does not pass at all.
Author

N68-15607# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FIGURES OF EQUILIBRIUM OF A HOMOGENEOUS ROTATING LIQUID IN AN EXTERNAL FIELD [O FIGURAKH RAVNOVESIYA ODNORODNOY VRASHCHAYUSHCHEYSYA ZHIDKOSTI VO VNESHNEM POLE]
M. G. Rabinovich *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 81–86 refs

The method of L. Lichtenstein is used to investigate the problem of equilibrium figures of a homogeneous liquid rotating in an external potential field. The existence theorem of equilibrium figures is proved in the case when the vector value of the field is small enough. In the case when this vector is a periodic function of time, the existence of the tide is proved. The equilibrium figure consisting of a solid nucleus and liquid atmosphere is also considered.
Author

N68-15610# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC STRUCTURE OF A BOUNDARY LAYER FOR LARGE M [K ASIMPTOTICHESKOY STRUKTURE POGRANICHNOGO SLOYA PRI BOL'SHIKH M]

R. G. Barantsev and Yu. Shlazha *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 115–118 refs (See N68-15601 06-23)

The nonequilibrium, asymptotic behavior of the macroscopic parameters of particle flow, generated at the wall, is analyzed at high Mach numbers. The flow of a monatomic gas outside the boundary layer is described by a Maxwellian distribution function and particle flow to the wall in limit $M \to \infty$ is given by a triple integral function. For diffusely reflected molecules colliding only with molecules coming from outside the boundary layer, the distribution function takes another equation form. The asymptotic behavior of the macroscopic parameters of the flow described by this second equation is then analyzed for $M \to \infty$, $y \geq 0$. For $\alpha = \gamma M(5/6)^{1/2}$ this yields an expression for the number density. Similar nonequilibrium behavior is observed with other macroscopic parameters, such as the velocity. The thickness of the boundary layer for this situation is inversely proportional to M. Author

N68-15612# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DAMPING OF SHOCK WAVES IN WATER [O ZATUKHANII UDARNYKH VOLN V VODE]

A. A. Grib and N. S. Medvedeva *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 133–147 refs (See N68-15601 06-23)

Hydrodynamic equations are solved for the flow behind the front of a weak shock wave in water. It is shown that the pressure curve at a given point does not coincide with that of the velocities of the particles. The maximal pressure along the wavefront changes with distance according to L. D. Landau's law. L.S.

N68-15613# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EQUILIBRIUM STATISTICAL DISTRIBUTIONS FOR GASES, DIFFERENT FROM BOLTZMANN DISTRIBUTION [RAVNOVESNYE STATISTICHESKIYE RASPREDELENIYA DLYA GAZOV, OTLICHAYUSHCHIYESYA OT RASPREDELENIYA BOL'TSMANA]

S. V. Vallander, I. A. Yegorova, and M. A. Rydalevskaya *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 149–153 refs (See N68-15601 06-23)

It is proved that if the detailed balance is not true, the equilibrium kinetic equations give a statistics different from that of Boltzmann's. Author

N68-15614# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LAMINAR BOUNDARY LAYER OF GAS ON A FLAT PLATE WITH CALCULATION OF THERMODYNAMIC AND CHEMICAL NONEQUILIBRIUM [LAMINARNYY POGRANICHNYY SLOY GAZA NA PEOSKOY PLASTINE S UCHETOM TERMODINAMICHESKOY I KHIMICHESKOY NERAVNOVESNOSTI]

L. A. Ladnova *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 155–172 refs (See N68-15601 06-23)

The laminar boundary layer on a flat plate is first considered in the presence of vibrational relaxation; dissociation and recombination of gas atoms being neglected. An expression is derived for the thermal flux density with the diffusion of vibrational energy taken into account by using the simplified scheme proposed by Hirschfelder. An approximation method is outlined for solving laminar boundary layer equations in cases of thermodynamic nonequilibrium flow, near frozen flow, and near equilibrium flow. A qualitative analysis of the effect of relaxation on heat transfer processes between the cooled and thermoinsulated flat plate and gas flow is presented. The effect of chemical and thermal nonequilibrium on the laminar boundary layer in the presence of dissociation and recombination is also considered, and an equation is derived for vibrational energy relaxation. Author

N68-15639*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

SCALE MODEL STUDY OF FLOW PATTERNS IN THE INLET MANIFOLD OF THE FUEL PUMP DRIVE TURBINE FOR THE M-1 HYDROGEN-OXYGEN ROCKET ENGINE

John F. Kline and Roy G. Stabe Washington Feb. 1968 11 p refs

(NASA-TM-X-1513) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Flow conditions in the inlet manifold of the M-1 fuel pump-drive turbine were investigated using circumferential static pressure measurements in conjunction with smoke trace photographs. This manifold is toroidal with a single radial feedpipe. The study was prompted by reference tests which indicated a large variation in total pressure around the turbine nozzle which was attributed to manifold flow conditions. In addition, the possibility of flow asymmetry in the manifold was indicated by circumferential measurements of manifold static pressure. The results obtained from both the static pressure measurements and smoke flow traces indicated that the flow pattern within this manifold was essentially symmetrical about the feedpipe. The large observed circumferential variation in static pressure and associated flow patterns afforded a better understanding of reference nozzle exit total pressure patterns. Author

N68-15664# Aeronautical Research Council (Gt. Brit.)

THE ISOBARS IN BOUNDARY LAYERS AT SUPERSONIC SPEEDS

D. F. Myring (London Univ.) and A. D. Young (London Univ.) Apr. 1967 47 p refs

(ARC-29142) CFSTI: HC $3.00/MF $0.65

For boundary layer flows over curved surfaces at moderately high supersonic speeds the existence of normal pressure gradients within the boundary layer becomes important even for small curvatures and they cannot be ignored. The describing equations are basically parabolic in form so that the simplifications inherent in hyperbolic flows would not at first sight seem to be relevant. However, the equations of motion for a two-dimensional, supersonic, rotational, viscous flow are analyzed along the lines of a hyperbolic flow and the individual effects of viscosity and vorticity are examined with regard to the isobar distributions. It is found that these two properties have compensating effects and the experimental evidence presented confirms the conclusion that inside the boundary layer the isobars follow much the same rules as those which determine the isobars in the external hyberbolic flow. Since for turbulent boundary layers the fullness of the Mach number profile produces almost linear Mach lines in the boundary layer, this provides a simple extension to the methods of analysis, and the momentum integral equation is reformulated using a swept element bounded by linear isobars. The final equation is similar in form to the conventional one except that the momentum and displacement thicknesses are now defined by integrals along the swept isobars, and all normal pressure gradients due to centrifugal effects are accounted for. Author (ESRO)

N68-15711# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

EXPERIMENTAL INVESTIGATION OF FLOW OF RAREFIED GAS [ESKPERIMENTAL'NOYE ISSLEDOVANIYE TECHENIYA RAZREZHENNOGO GAZA]

G. A. Yevseyev 31 Mar. 1967 18 p refs Transl. into ENGLISH from Akad. Nauk. SSSR. Izv. Mekhan. (Moscow), no. 3, 1965 p 165–172

(FTD-MT-67-22; AD-662502)

Experimental investigation was conducted of nondesign expiration of rarefied gas from nozzle. It was demonstrated that width of zone of pressure propagation upstream is considerable. At the nozzle wall it is equal to 3-5 thicknesses of boundary layer, determined ahead of region of interaction. Obtained values of pressure coefficients agree with available experimental results related

to interaction of laminar boundary layer on plate with shock waves at large values of Reynolds number R = 1000 to 10,000,000. Experimental investigation was conducted, of influence of rarefaction on readings total pressure cap and conical cap. For cylindrical total pressure cap correction for rarefaction in investigated range of variation of parameters reaches 30%; for conical cap the measured static pressure on surface of cone was higher than ideal by 1.5-2 times. It was established that the determining parameter for calculating influence of rarefaction on indications of cylindrical total-pressure cap will be the ratio of Mach number to Reynolds number, M/R. Author (TAB)

N68-15759# Aeronautical Research Council (Gt. Brit.)
THE TRANSONIC FLOW IN THE THROAT REGION OF A TWO-DIMENSIONAL NOZZLE WITH WALLS OF ARBITRARY SMOOTH PROFILE
A. W. Moore London HMSO 1967 27 p refs Supersedes ARC-26542 See X66-13406
(ARC-R&M-3481; ARC-26542) CFSTI: HC $3.00/MF $0.65

A solution is obtained for the flow in the throat region of a two-dimensional nozzle with an arbitrary smooth profile. The velocity components are determined as series expansions in inverse powers of the mean radius of curvature of the profile at the throat. The solution of the indirect problem is also discussed. An axial velocity distribution of arbitrary form is assumed and the velocity components are obtained as series expansions in terms of the non-dimensional velocity gradient along the axis at the throat. The coefficients of each power of this parameter are determined as closed expressions. Author (ESRO)

N68-15760# Aeronautical Research Council (Gt. Brit.)
TRANSONIC FLOW IN THE THROAT REGION OF AN ANNULAR NOZZLE WITH AN ARBITRARY SMOOTH PROFILE
A. W. Moore and M. Hall London HMSO 1967 32 p refs Supersedes ARC-26543 See X66-13362
(ARC-R&M-3480; ARC-26543) CFSTI: HC $3.00/MF $0.65

The flow in the throat region of an axially-symmetric nozzle with a centerbody of arbitrary shape is considered. In general, the flow direction in the throat is inclined to the axis of symmetry. The analysis indicates that the cases in which the angle of inclination is large require separate consideration from cases in which the angle is small, and an approximate solution is determined in each instance. Author (ESRO)

N68-15762# Aeronautical Research Council (Gt. Brit.).
A NUMERICAL METHOD FOR SOLVING THE EQUATIONS FOR A VORTEX CORE
M. G. Hall London HMSO 1967 32 p refs Supersedes RAE-TR-65108; ARC-27150 See X66-10427
(ARC-R&M-3467; RAE-TR-65106; ARC-27150) CFSTI: HC $3.00/MF $0.65

A method is presented for calculating steady axially symmetric spiralling motions of an incompressible fluid at large Reynolds numbers. By making approximations of the boundary-layer type the Navier–Stokes equations are reduced essentially to a pair of non-linear parabolic equations. Initial conditions are specified on some upstream cross-section, and boundary conditions on the axis of symmetry and on some bounding surface of revolution. The method involves replacing the differential equations by sets of finite-difference equations, using first-order central differences in an implicit scheme. The calculation is by a marching technique, which proceeds step-by-step in the axial direction. For each step an iterative plan is followed. The finite-difference equations themselves are solved by straight-forward matrix methods. A programme is developed for a digital computer of moderate size and examples of the application of the method are given. Author (ESRO)

N68-15776# National Physical Lab., Teddington (England). Aerodynamics Div.
MEASUREMENTS OF THE WAVE NUMBER PHASE VELOCITY SPECTRUM OF WALL PRESSURE BENEATH A TURBULENT BOUNDARY LAYER
J. A. B. Wills 3 Feb. 1967 50 p refs Prepared for Min. of Technol.
(NPL-AERO-1224; ARC-28773) CFSTI: HC $3.00/MF $0.65

Measurements are presented of the wave number/frequency and wave number/phase velocity spectrum of wall pressure for a two-dimensional turbulent boundary layer in zero pressure gradient, obtained from a Fourier transform of experimental filtered spatial correlations. This method allows the results to be corrected for acoustic disturbances in the wind tunnel, and for finite transducer size. An empirical form for the pressure field is proposed, based on the measurements, and is used to predict a frequency spectrum correction for transducer size which agrees well with measured values. Author (ESRO)

N68-15781* Electro-Optical Systems, Inc., Pasadena, Calif.
STUDY OF LIQUID DROP DYNAMICS IN ZERO GRAVITY Final Report
Karl K. Knapp 2 Nov. 1967 106 p refs
(Contract NAS8-21012)
(NASA-CR-61476; EOS-7170-Final) CFSTI: $3.00 CSCL 20D

Experiments to study the behavior of fluids near their critical state and the dynamics of liquid drops under weightless conditions have been defined and evaluated. The selection of suitable experiments has been based on both technological importance and flight feasibility. Pilot experimental tests of breadboard systems have demonstrated the feasibility of the experiments and the adaptability of the apparatus to space flight. Author

N68-15799# Aeronautical Research Council (Gt. Brit.).
POTENTIAL FLOW THEORY FOR TANDEM CASCADE BY HOWELL'S METHOD
Y. M. Yipp (Birmingham Univ.) and J. W. Railly (Birmingham Univ.) London HMSO 1967 51 p refs Supersedes ARC-27510 See N67-14972
(ARC-CP-971; ARC-27510) CFSTI: HC $3.00/MF $0.65

The solution of a tandem cascade is obtained by replacing the second blade by singularities (two in this case), and carrying out an exact conformal transformation of the first blade by Howell's method. A digital computer program which deals with the numerical work of the fianl Karman–Theodorsen transformation in a new way is described. Author (ESRO)

N68-15841# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CALCULATING THE DIRECTION OF THE AXIS OF THE RESULTANT FLOW DURING MIXING OF TURBULENT JETS [RASCHET NAPRAVLENIYA OSI REZUL'TIRUYUSHCHEGO POTOKA PRI SMESHENII TURBULENTNYKH STRUY]
V. A. Kirillov and B. G. Khudenko 27 Jul. 1967 9 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 9, no. 5, 1965 p 654–656
(FTD-AT-23-531-67; AD-662791)

The possibility of calculating, according to a simplified method, the deflection of the axis of the resultant flow that forms during mixing of turbulent jets is investigated. Author (TAB)

N68-15847*# Massachusetts Inst. of Tech., Cambridge. Fluid Dynamics Research Lab.
A FORTRAN COMPUTER CODE FOR THE CALCULATION OF UNSTEADY SUPERSONIC FLOW FIELD BY THE METHOD OF PERTURBATION
Pao-tan Hsu Huntsville, Ala. NASA Sep. 1967 44 p refs
(Contract NAS8-873)
(NASA-CR-61493; Rept.-67-3) CFSTI: HC $3.00/MF $0.65 CSCL 20D

This report describes a computer code written in FORTRAN language code—named UNFLAVOR I. It computes the unsteady flow field around a body of revolution performing lateral oscillation by the method of small perturbation and method of characteristics. The nonlinear steady flow field upon which the present computation is derived is also computed by the method of characteristics. Author

N68-15876# Mitsubishi Heavy Industries, Ltd., Nagasaki (Japan).
ANALYSIS OF HYDRAULIC PIPELINE NETWORK USING AN ELECTRONIC COMPUTER
Tsunaichi Ito (Hiroshima Tech. Inst., Japan), Hiroko Fukaye (Hiroshima Tech. Inst., Japan), Zenzo Okamoto (Hiroshima Shipyard and Eng. Works, Japan), and Hiroyuki Hoshino (Hiroshima Shipyard and Eng. Works, Japan) 1967 10 p refs In JAPANESE; ENGLISH summary
(MTB-010046)

It is one of the most important engineering problems to calculate pressure drops and flow distributions in pipeline networks. The method of analysis so far adopted includes the use of the electrical simulator and the digital computer. Hardy–Cross method has been the most extensively used one. However, this method assumes that the flow-pressure drop relation has such a simple form as $\Delta P = k\Omega^2$, and cannot be applied to the networks which contain open loops. In this paper, we improved Hardy–Cross method. This improved method can analyze flow distributions in more general networks which have no limitations, and flow-pressure drop relation may have more general form $\Delta P = F(Q)$. We measured flow distributions in the pipeline network of the cooling sea water system for a marine engine. Those data were compared with calculated result, showing a good agreement. Author

N68-15974*# Southern Methodist Univ., Dallas, Tex. Inst. of Technology.
SYMMETRICAL AND UNSYMMETRICAL FLOW SEPARATION IN SUPERSONIC NOZZLES
Roy Albert Lawrence (Ph.D. Thesis) 6 Apr. 1967 209 p refs
(Grant NGR-44-007-006)
(NASA-CR-92587; RR-67-1) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The flow structure in several contoured and straight-walled, two-dimensional nozzles was examined by means of schlieren photography with single-frame and high-speed motion picture cameras, and with short-exposure shadowgraphs. Symmetrical, unsymmetrical and unstable separation in contoured and conical axi-symmetric nozzles was investigated by making transient and time-average measurements of static pressures along several sides of the nozzle walls simultaneously. Unstable and unsymmetrical separation in axi-symmetric nozzles is shown to be a consequence of the combined effects of entrainment, and of the shock and flow-turning angles associated with separation. The effects of boundary-layer transition are also considered. The results of experiments to produce and control the deflection of two-dimensional and axi-symmetric jets by means of forced separation are presented. Author

N68-15984# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.
DEPARTMENT OF FLUID MECHANICS
Wladyslaw Fiszdon *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 12–17 refs (See N68-15982 06-34)

Continuing theoretical and experimental research in fluid dynamics is reported. Dissipation, boundary value problems, and shock waves in transonic flows were studied. In conjunction with hypersonic flow research, detached shock wave flows were emphasized, and body resistance in a rapidly accelerated flow was investigated. Problems in mathematics, rarified gas dynamics, oscillating flow, and aeroelasticity are mentioned. N.E.N.

N68-16006*# Techtran Corp., Glen Burnie, Md.
NOTES ON MY PAPER LINEAR DISCONTINUOUS BOUNDARY PROBLEMS IN THE THEORY OF FUNCTIONS, SINGULAR INTEGRAL EQUATIONS AND SOME OF THEIR APPLICATIONS [ZAMECHANIYE K MOYEY RABOTE LINEYNYYE RAZRYVNYYE GRANICHNYYE ZADACHI TEORII FUNKTSIY, SINGULYARNYYE INTEGRAL'NYYE URAVNENIYA I NEKOTORYYE IKH PRILOZHENIYA]
B. V. Khvedelidze Washington NASA Jan. 1968 3 p refs Transl. into ENGLISH from Soobshcheniya Akad. Nauk Gruzin. SSR (Tiflis), v. 21, no. 2, 1958 p 129–130
(Contract NASw-1695)
(NASA-TT-F-11492) CFSTI: HC $3.00/MF $0.65 CSCL 19A

It is shown that in an earlier work, in which the author studied the boundary problem in the theory of functions of a complex variable, the results were incomplete. The class D(Γ) in these results can be replaced by a class of continuous functions (class C(Γ) by showing that if Γ is a single, closed, simple Lyapunov line and a(t) is a continuous, nonzero function defined on this line, it can be represented by a canonical function. This result makes it possible to generalize the results of the earlier work. Author

N68-16017# Naval Ordnance Lab., White Oak, Md.
AN APPROXIMATE SOLUTION FOR COMPRESSIBLE AXISYMMETRIC LAMINAR BOUNDARY LAYERS INCLUDING THE EFFECTS OF TRANSVERSE CURVATURE
Jay M. Solomon and Bernard S. Loeb 21 Jul. 1967 86 p refs
(NOLTR-67-108; RR-282; AD-662187)

An approximate momentum integral solution for the compressible axisymmetrix laminar boundary layer when transverse curvature effects are important is presented. Both finite and infinite inviscid Mach numbers are considered. Detailed comparisons with exact asymptotic solutions are given. The method is found, in many instances, to agree to leading order with the exact solutions as the transverse curvature becomes very large--a property that none of the existing approximate solutions for compressible flow possess. Some example calculations for a cone in supersonic and hypersonic flow are presented. Also, the method is applied to the hypersonic self-induced pressure problem for a cone. Author (TAB)

N68-16033 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONSTATIONARY PROBLEM THE DISSIPATION OF JET [NESTATSIONARNAYA ZADACHA O RAZMYVE STRUI]
A. V. Belova and G. G. Maksimova *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 87–96 refs (See N68-16026 06-23)

It is concluded that the approximation under discussion provides a good description for the development of the process at its beginning, although the solution provides only a qualitative description of the flow pattern later on. The author presents a method for using his approximations to solve several problems on nonstationary dissipation in the case of one or more regions of gas moving in parallel. Author

N68-16035 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TURBULENT BOUNDARY LAYER ON A PENETRABLE FLAT PLATE [TURBULENTNYY POGRANICHNYY SLOY NA PRONITSAYEMOY PLASTINKE]
I. P. Ginzburg, G. V. Kocheryzhenkov, and N. I. Mordvinova *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 103–119 refs (See N68-16026 06-23)

The effect of mass transfer on compressible, turbulent-boundary-layer skin friction and on heat transfer when mass is injected into or withdrawn from the layer normal to the surface of a permeable plate is studied for arbitrary constant Prandtl and Lewis numbers. Investigations were carried out on the basis of a semiempirical theory of turbulence by means of a two-layer method proposed by I. P. Ginzburg. Steady flow of a

thermodynamically ideal gas is considered in the presence of diffusion and in the absence of inertial forces, heat emission, and chemical reactions. The effect of thermal diffusion is neglected. Formulas expressing relations between total enthalpy and velocity, mass concentration of the components of a binary mixture and velocity, and shear stress and layer thickness are derived. Expressions for determining velocity and temperature profiles and evaluating the effect of injection on the skin-friction coefficient are established.
Author

N68-16037 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTAL INVESTIGATION OF THE INITIAL STAGE OF STREAM FORMATION [EKSPERIMENTAL'NOYE ISSLEDOVANIYE NACHAL'NOY STADII OBRAZOVANIYA STRUI]
A. I. Starshinov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 129–133 refs (See N68-16026 06-23)

The formation of a gas stream behind a shock wave discharging into the atmosphere from a shock-tube nozzle was studied experimentally by schlieren photography using shock tubes of different diameters (30, 50, and 89 mm). Analysis of the series of motion-picture photographs obtained showed decay of the shock wave after passage through the shock-tube nozzle. This decay resulted in the formation of a contact surface dividing the gas discharging from the shock tube and the gas outside the nozzle. Due to expansion, the gas velocity becomes supersonic, and a secondary shock wave and a vortex ring are formed which propagate in the same direction as the gas stream. The positions of the fronts of the primary and the secondary shock waves and of the vortex ring were determined as a function of time by measuring the distances on the photographs.
Author

N68-16046 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROTATIONAL MOTION OF A SPHERE IN A RARE FLOW OF HIGH SPEED [O VRASHCHATEL'NOM DVIZHENII SHARA V RAZREZHENNOM POTOKE SKOROSTI]
Nam Tum Po *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 209–217 refs (See N68-16026 06-23)

The spinning motion of a sphere in a high velocity, rarefied gas flow is investigated under the assumptions that the mean free path of the molecules is larger than the characteristic size of the body; that the impact of the molecules upon the surface is inelastic; and that the surface velocity is much greater than the thermal velocity of the gas molecules. The law of drag variation and the negative moments of a sphere moving through a fluid are established. Some particular solutions are considered, including the motion of a sphere relative to the center of inertia and the case when the spin axis does or does not coincide with any of the axes of inertia.
Author

N68-16060# Syracuse Univ. Research Inst., N. Y. Dept. of Mechanical and Aerospace Engineering.
INVESTIGATION OF INTERACTING JET FLOWS. PART 2: (A) SINGLE, TWO-DIMENSIONAL UNDEREXPANDED JET FLOWS FROM A SONIC NOZZLE; (B) INTERACTION OF TRANSVERSELY IMPINGING TWO-DIMENSIONAL JET FLOWS Final Report
William J. Sheeran and Darshan S. Dosanjh Aug. 1966 294 p refs
(Grants NSF GK-568; NSF GP-1137)
(ME-1058-6608F; PB-176167)

Experimental and analytical investigations of a single underexpanded, two-dimensional jet flow from a sonic nozzle, and the transverse impingement onto it of a side two-dimensional jet, were conducted. Shadowgraphic, schlieren, and interferometric data were recorded and analyzed. A characteristics solution for the flow field of the underexpanded two-dimensional jet issuing from a nozzle with uniform exit conditions was developed; the computer programs used for the solution are included. A flow model for the transverse impingement of a two-dimensional side jet onto an underexpanded, two-dimensional main jet flow was modified. Several approaches based on the method of characteristics, are discussed for calculating the main jet flow resulting from the transverse impingement of the two-dimensional side jet onto the underexpanded, two-dimensional main jet. The acoustic emission characteristics of the transversely impinging jets, as observed in optical records, were also considered.
Author

N68-16064*# Hydronautics, Inc., Laurel, Md.
THE HIGHER ORDER THEORY OF SUPERCAVITATING CASCADES WITH CONSTANT PRESSURE CAMBERED BLADES
B. Yim Oct. 1967 33 p refs
(Contract NAS8-20625)
(NASA-CR-61444; TR-703-3) CFSTI: HC $3.00/MF $0.65 CSCL 20D

A solution is proposed for the nonlinear problem of supercavitating, constant pressure cambered cascades with finite cavities. For the numerical computation, the drag coefficient of the cascade with a given set of parameters is calculated. The first and second order problems are considered, and it is shown that a second order correction can be made from the results obtained in the first order theory. For the mathematical model of the collapse of the cavity, the double spiral vortex model is adopted as in the case of the linear theory. Comparisons are made with other approaches to solving the problem, and a reference bibliography is included.
Author

N68-16066*# Wisconsin Univ., Madison. Dept. of Mechanical Engineering.
MATHEMATICAL EXPRESSION FOR DROP SIZE DISTRIBUTION IN SPRAYS
Hiroyuki Hiroyasu (Toyota C.R.D. Lab., Nagoya, Japan) 1 Nov. 1967 64 p refs
(Grant NsG-601)
(NASA-CR-72272) CFSTI: HC $3.00/MF $0.65 CSCL 20D

The theoretical soundness of applying the logarithmic normal and the Chi-square distribution functions to drop size distributions is discussed and several figures that are useful when applying them to spray data are included. It is shown how some empirical drop size distributions can be derived from the general Chi-square distribution function. This suggests that it may be possible to relate the parameters in the Chi-square distribution equation to the fundamental mechanisms of spray formation. It is concluded that the Chi-square distribution fits the available spray data well, can be graphed fairly simply, and furthermore if the parameters β and ϕ are defined, several expressions of distribution (volume, number, cumulative, etc.) can be found and several types of mean diameters can be calculated.
Author

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N68-15026 Joint Publications Research Service, Washington, D. C.
SOVIET-BLOC RESEARCH IN GEOPHYSICS, ASTRONOMY, AND SPACE, NUMBER 172
16 Jan. 1968 116 p refs Transl. into ENGLISH from Russian (JPRS-44033)

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1. ASTRONOMY p 1–5 refs (See N68-15027 06-30)
2. METEOROLOGY p 6–33 refs (See N68-15028 06-20)
3. OCEANOLOGY p 34–43 refs (See N68-15029 06-13)
4. TERRESTRIAL GEOPHYSICS p 44–69 refs (See N68-15030 06-13)
5. UPPER ATOMOSPHERE AND SPACE RESEARCH p 70–94 refs (See N68-15031 06-13)
6. MISCELLANEOUS p 95–98 refs (See N68-15032 06-20)

N68-15029 Joint Publications Research Service, Washington, D. C.
OCEANOLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 34–43 refs Transl. into ENGLISH from Izv. (Moscow), 10 Dec. 1967 p 6 (See N68-15026 06-13)

Abstracts of books and journal articles are presented on recent and historical studies of oceanography. Among the topics covered are the following: determination of the bottom relief; the use of aerial photography in oceanographic studies; turbulence and turbulent mixing in oceans; sediment studies; oscillations of electrical fields in the oceans; and ocean-atmosphere interactions and waves. N.E.N.

N68-15030 Joint Publications Research Service, Washington, D. C.
TERRESTRIAL GEOPHYSICS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 44–69 refs Transl. into ENGLISH from Russian (See N68-15026 06-13)

Summarized data are presented on earth science studies. The areas investigated include the following: petrology; seismology and the use of seismic waves in determining earth densities; gravitational and geomagnetic fields, anomalies, and variations; prospecting; and instrumentation and methods connected with these studies. N.E.N.

N68-15031 Joint Publications Research Service, Washington, D. C.
UPPER ATMOSPHERE AND SPACE RESEARCH
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 70–94 refs Transl. into ENGLISH from Russian (See N68-15026 06-13)

News briefs and reviews are given on geophysical studies of the upper atmosphere. The topics include the following: cosmic rays; auroral activity; sky brightness; meteors and meteor trails; electron densities in the ionosphere, characteristics of the F layer, F region, and sporadic E layer; solar activity effects on magnetic disturbances and electron densities; and space probes and measurements obtained by Cosmos satellites. N.E.N.

N68-15098*# Stanford Research Inst., Menlo Park, Calif.
RESEARCH RELATED TO MEASUREMENTS OF ATOMIC SPECIES IN THE EARTH'S UPPER ATMOSPHERE Quarterly Status Report
Bernard J. Wood 1 Dec. 1967 8 p refs
(Grant NASr-49(30)-05-019-930)
(NASA-CR-92567; QSR-2) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The kinetics and mechanisms that are associated with the interaction of oxygen atoms with different solid surfaces, under conditions similar to those encountered in the upper atmosphere, are investigated. In the experiment, an electrically heated foil was placed in a chamber and suddenly exposed to a gaseous environment of fixed pressure. The rate of sorption of gas on this specimen was reflected in the change in gas flow into the system through the inlet conductance. Experiments demonstrate that a significant fraction of the metallic surface is populated with sorbed oxygen rather quickly even at molecular O_2 pressures in the 10^{-8} torr region. Electrochemical studies of oxygen sorption on a platinum electrode have shown a maximum surface coverage of about 20%. Data suggest that about 3% to 5% of the impinging molecules are sorbed until the surface coverage attains approximately one-tenth of a monolayer. B.S.D.

N68-15126# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.
BALL LIGHTNING RESEARCH AT HIGHLAND LOOKOUT, MONTANA
K. M. Evenson Jan. 1968 17 p ref
(DAC-60941)

The observed lighning activites during several storms are described. Several lightning balls and considerable corona discharge are reported. The equipment at the site is also described, and includes cameras, magnetic compasses, electric field detector–transmitters, and a battery-operated communications receiver. N.E.N.

N68-15142*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ROLE OF LITHOPHILOUS LICHENS IN THE WEATHERING OF MASSIVE CRYSTALLINE ROCKS
Ye. A. Yarilova [1967] 23 p refs Transl. into ENGLISH from Pochvovedenie (Moscow), no. 3, 1947 p 533–548
(Contract NAS7-100)
(NASA-CR-92522) CFSTI: HC $3.00/MF $0.65 CSCL 08D

A literature survey is given on the areas of research undertaken to investigate the role of lithophilous lichens in the weathering of massive crystalline rocks. These findings are compared with the chemical analysis of the rock and the ash analysis of various lichens. Three general conclusions are drawn: (1) Lichens play a great role in the weathering of massive crystalline rocks in that they break it down both by mechanical disaggregation and biochemical decomposition of the separate minerals in the rock. (2) The destructive effect of lichens on rock leads to the formation of a first layer of a small grained organomaterial mass. This is the rudimentary stage of soil that is suitable for more highly organized plant organisms. (3) The biochemical significance of lichens lies in the fact that they extract atoms of different elements from the inert mineral compounds first coming to the earth's surface. They form the first link in the complicated chain of the further transformations of these elements in the biosphere. B.S.D.

N68-15228# Alaska Univ., College. Geophysical Inst.
TELLURIC CURRENT MICROPULSATIONS AT THE AURORAL ZONE Final Report, Nov. 1962–Oct. 1967
Victor P. Hessler and Richard R. Heacock Oct. 1967 152 p refs
(Contracts AF 19(628)-1695; AF 19(604)-3075)
(UAG-R-202; AFCRL-67-0550; AD-662877)

The report presents analysis of individual events and statistical results derived from several years of continuous Pc 1 recording at College, using the telluric current technique. Histograms of occurrence distributions versus K sub p and versus pulse period, together with sonagrams, justify dividing Pc 1 into two main classes. Class 1 activity has pulse periods mainly shorter than 3 sec, is usually structured, has a pronounced mid-day maximum in occurrence, not much seasonal variation in occurrence, and has little occurrence relationship to K sub p except for a tendency to be

absent when K sub p is large. Class 2 Pc 1 activity has periods usually longer than 2 sec, is usually unstructured, has a very pronounced afternoon maximum in occurrence at College, a seasonal maximum in summer, and has a positive correlation with K sub p. College sonagrams of Pc 1 events show a great variety of frequency-time forms. Rising frequency periodic structures are most common, but falling frequencies are often seen sometimes superimposed on rising events. At times narrow band necklaces are clearly seen. Long duration structured events were observed with durations up to 18 hours. The long events tended to occur only at times of rather low K sub p. Author (TAB)

N68-15231# Space Instruments Research, Inc., Atlanta, Ga.
UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (YUMA, 26–27 OCTOBER 1966)
Marvin Anthony and William Epler Aug. 1967 39 p refs
(Contract DA-01-009-AMC-169(X))
(Rept.-7; AD-662727)

On the night of 26 October 1966, two luminous trails were produced between 87km and 160km by the release of tri-methyl-aluminum from projectiles fired from a smoothbore sixteen-inch gun located at Yuma Proving Ground, Arizona (114.2 degrees W, 32.8 degrees N). Two additional trails were produced on the night of 27 October 1966. These trails were photographed by cameras located at Yuma and Gila Bend in Arizona and at Blythe, California, and have been analyzed to yield wind profiles. The report contains the tabulated wind data for all four trails together with plots versus altitude of wind components, wind speed, and wind heading. Author (TAB)

N68-15288# Ludwig-Maximilians-Universitat, Munich (West Germany). Meteorologisches Institut.
INFRARED SPECTROSCOPY AS TOOL AND OBJECT OF METEOROLOGICAL AND PLANETARY RESEARCH [INFRAROTSPEKTROSKOPIE ALS HILFSMITTEL UND GEGENSTAND METEOROLOGISCHER UND PLANETARISCHER FORSCHUNG]
H.-J. Bolle Bad Godesberg, W. Ger. Bundesmin. fuer Wiss. Forsch. Jul. 1967 325 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-17)

In this paper the structure of the infrared atmospheric spectrum is investigated and a procedure developed to compute spectral radiances of planetary atmospheres. The basic data of these calculations are proved by comparison with measured spectra. For water vapor continuum absorption coefficients and line intensities are derived from emission spectra obtained at the ground. The computer program is capable for the computation of transmission and emission spectra as well as spectral heating rates. It can be accounted for the superposition of different atmospheric constituents. The radiation transfer within single lines is considered in detail. Possibilities are discussed to derive atmospheric parameters from analysis of its infrared spectra. Examples are given for the earth and planet Mars. Author

N68-15312# Nevada Univ., Reno. Mackay School of Mines.
SOLID EARTH TIDES AS A TRIGGERING MECHANISM FOR EARTHQUAKES
James D. Van Wormer Oct. 1967 72 p refs
(Grants AF-AFOSR-646-66; NSF-GP-5036; ARPA Order 292-66)
(AFOSR-67-2708; TR-5; AD-662354)

A review is presented of previous attempts to correlate earthquake occurrence with various other natural phenomena. These early studies were generally based on insufficient data, and therefore did not result in correlations that were acceptable to the scientific community. Continuous, highly sensitive monitoring of the 1966 Truckee, California, earthquake sequence presented the first opportunity to study rates of occurrence using a large number of observations collected in a small area. Time series analysis of 390 consecutive hours of data, totaling 10,550 earthquakes, yielded periodic components of occurrence of 12 1/2 and 25 hour periods; the known periods of earth tides. Crosscorrelation of aftershock frequencies with a Los Angeles earth-tide recording gave a correlation coefficient which was significant at the 95% level of confidence. Author (TAB)

N68-15320# McGill Univ., Montreal (Quebec). Space Research Inst.
AEROSPACE APPLICATION OF GUN LAUNCHED PROJECTILES AND ROCKETS
Charles H. Murphy (Ballistic Res. Labs.) and Gerald V. Bull 20 Mar. 1967 45 p refs Presented at Am. Astron. Soc. Symp., New Mexico State Univ., 22–24 Mar. 1967
(Contract DA-18-001-AMC-748(X))
(SRI-TL-1; AD-662058)

Project High Altitude Research Program (HARP) is directed toward the use of guns for scientific probing of the upper atmosphere. The attractive features of guns for this purpose are the basic economy of such a system and the high inherent accuracy of guns for placement at altitude as well as accuracy in ground impact. The basic liability for such an approach lies in the very high acceleration experienced by gun-launched payloads. The guns used in Project HARP vary in size from 5-inch and 7-inch extended guns on mobile mounts to transportable fixed 16-inch guns. Altitude performance varies from 20 pound, 5-inch projectiles reaching 240,000 feet to 185-pound, 16-inch projectiles reaching 590,000 feet. Single and multiple stage rockets launched from the 16-inch gun have very promising predicted performance and are under development. Scientific results to date are primarily wind profiles measured by radar chaff, aluminized balloons and parachutes, and tri-methyl-aluminum trails, although a number of successful 250 MHz and 1750 MHz telemetry flights have been made. Sun sensors, magnetometers, and temperature sensors have been flown and an electron density sensor was fired in early June. Development of other active sensors is continuing. Author (TAB)

N68-15340# Brown (D.) Associates, Inc., Melbourne, Fla.
PRECISE DETERMINATION OF GEODETIC POSITIONS BY THE METHOD OF CONTINUOUS TRACES Final Report, May 1966–Sep. 1967
Duane C. Brown and Jerry E. Trotter 15 Sep. 1967 171 p refs
(Contract AF 19(628)-6046)
(AFCRL-67-0558; AD-662013)

The Method of Continuous Traces exploits time-free short arc dynamic constraints to extract precise geodetic positions from measurements of uninterrupted photographic traces of sun-illuminated passive satellites recorded against the stellar background. The mathematical development of the method is presented and expected accuracies are discussed. An operational computer program designed to implement the method is also developed and discussed. Author (TAB)

N68-15342# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. fuer Ionosphaerenphysik.
INFLUENCE OF THE EARTH MAGNETIC DISTURBANCES ON THE USABLE FREQUENCY BAND IN THE SHORT WAVE RADIO TRANSMISSION AT THE FRINGE OF AURORAL ZONE [EINFLUSS DER ERDMAGNETISCHEN UNRUHE AUF DEN BRAUCHBAREN FREQUENZBEREICH IM KURZWELLEN-WEITVERKEHR AM RANDE DER NORDLICHTZONE]
Jih-chen Ma (Taiwan Univ.) Heidelberg Springer 1965 29 p refs In GERMAN; ENGLISH summary Sponsored by the Humboldt Stift.
(Rept.-24/1965) CFSTI: HC $3.00/MF $0.65

The deviation of FJF (junction frequency of the F layer) and MOF (maximum observed frequency) of the oblique transmission path (Sodankylä – Lindau, 2000 km) from the running median of 27 days of MUF 2000 in Uppsala (the control station in the

middle of that transmission path) in relation to the earth magnetic disturbance has been statistically analyzed for a period of two years. It shows a striking increase of this deviation (up to 80 %) during increasing magnetic disturbances in the winter night, especially after the midnight. A further statistical study was also conducted at three vertical sounding stations along the transmission path. At Uppsala and north a similar result was obtained; south of Uppsala a simple decrease of the deviation was found. Therefore, during the strong earth magnetic disturbances in the northern half-path a large horizontal gradient of the critical frequency results, which brings about an enhancement of the deviations of FJF and MOF about their means during most of the strong earth magnetic disturbances. A statistical analysis of the deviation of LOF (lowest observed frequency) from its running median of 27 days shows a strong increase (up to 130 %) during strong earth magnetic disturbances and during all the seasons, especially around midnight. From the result obtained above, it is concluded that the usable frequency band for radio transmission in winter nights during increasing earth magnetic disturbances will not shrink from both sides, but instead the band will generally move upwards. This result could be applied in order to improve the predictions of usable frequency band at the fringe of auroral zone during strong earth magnetic disturbances. Author (ESRO)

N68-15348*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

FRICTIONAL FORCES AND COLLISON FREQUENCIES BETWEEN MOVING ION AND NEUTRAL GASES

Peter Stubbe Nov. 1967 44 p refs

(NASA-TM-X-63079; X-615-67-631) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Two different terms are used in literature for the frictional force between moving ion and neutral gases. It is shown how the corresponding collision frequencies have to be defined in order to keep both terms valid. An expression is derived for the momentum transfer collision frequency ν_{in} between ions and neutral particles as a function of temperature and the relative flow velocity $|\underline{v}_i - \underline{v}_n|$. The results indicates that for most practical applications ν_{in} may be considered as independent of $|\underline{v}_i - \underline{v}_n|$. However, for very high velocities, e.g. a convection flow from the magnetosphere into the ionosphere, this dependence may be significant. Numerical values for ν_{in} are presented. In the case of collisions between ions and their parent neutral gases, laboratory values are used for the resonant charge exchange cross section obtained for high energies, but a correction is made for the much smaller thermal energies in the temperature range typical for ionospheric conditions. This gives rise to an enhancement of the collision frequencies, compared with the values obtained from the uncorrected charge exchange cross sections, the amount of which depends on the particle mass. Author

N68-15350# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. für Stratosphärenphysik.

ON THE RADIATION ABSORPTION AND EMISSION OF THE ATMOSPHERIC OZONE LAYER AT THE WAVELENGTH 9.6μ [UEBER DIE ABSORPTIONS UND EMISSIONSSTRAHLUNG DER ATMOSPHAERISCHEN OZONSCHICHT BEI DER WELLENLAENGE 9,6μ]

Horst Specht 1967 43 p refs In GERMAN; ENGLISH summary Sponsored by the Deutsche Forsch. Gemeinschaft

(Rept.-29/1967) CFSTI: HC $3.00/MF $0.65

The emission spectra of the sun and the earth's atmosphere between 8 μ and 11 μ wavelength were measured by means of a heliometer and infrared spectrometer and the percentage absorption and emission, respectively, of the atmospherical ozone layer were computed. The results show that the total amount of ozone above a station, in spite of the dependence on pressure of the absorption coefficient in the infrared, can be derived with some accuracy from the absorption spectra. In considering the model of ozone layers the inexact knowledge of the temperature, of the concentration of ozone and of the absorption coefficient in each layer is undesirable. With the aid of balloon flights simultaneous with the infrared records the concentration of ozone and the temperature in each layer could be measured directly. Then the unknown absorption coefficients could be derived with the aid of the radiation measured on the ground at different zenith angles from a system of i equations, where i is the number of layers. Author (ESRO)

N68-15363# Max-Planck-Institut fur Aeronomie, Lindau uber Northeim (West Germany). Inst. für Stratosphärenphysik.

ON THE TWENTY-SEVEN-DAY RECURRENCE TENDENCY IN GEOMAGNETIC ACTIVITY DEDUCED FROM DAILY CHARACTER FIGURES C8 FROM 1884–1964 [ZUR 27TAEGLICHEN WIEDERHOLUNGSNEIGUNG DER ERDMAGNETISCHEN AKTIVITAET, ERSCHLOSSEN AUS DEN TAEGLICHEN CHARAKTERZAHLEN C8 VON 1884–1964]

Joachim Meyer 1965 81 p refs In GERMAN; ENGLISH summary

(Rept.-22/1965)

The 'equivalent recurrence number' $\omega(n)$ used in this paper is an individual measure of the recurrence tendency within already a few solar rotations. It states directly how many times, among n sets of 27 days each, statistically independent sets are repeated. Starting from the series of daily character figures C8, comprising the 81 years 1884–1964, the equivalent recurrence numbers $\omega(n)$, n being 2,4,8,16,32, and in 1942– 45 also 64, have been calculated for each (mean) solar rotation number. They have been used for investigating the systematic behavior of the recurrence tendency shortly after sunspot-minimum was shown to be clearly pronounced in almost every cycle, sometimes it occurs even before the minimum. The length of the recurrence interval has been determined by the maximum of recurrence tendency for variable period. The statistical background (noise-level) of the equivalent recurrence numbers was established experimentally by the Bartels shaking-test, applied to the original tables of C8 and to the round C8-deviations. The deduction of the used formulae is given within some general reflections on the time series dealt with. At the same time the connection between the equivalent recurrence number $\omega(n)$ and the correlation coefficients has been set forth as well as a vector model for illustrating $\omega(n)$. Author (ESRO)

N68-15376# Akademiya Nauk URSR, Kiev.

GEOPHYSICS AND ASTRONOMY, NO. 9

1966 206 p refs In RUSSIAN; ENGLISH summaries

Reports are presented on the geologic structure of the earth's crust, geomagnetic field, ionosphere, and meteoroids. For individual papers see N68-15377 to N68-15406. N.E.N.

N68-15377# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.

ON THE POSSIBILITY OF THE QUANTITATIVE MEASUREMENT OF INFORMATION OBTAINED BY THE METHODS OF GEOPHYSICAL EXPLORATION

E. K. Lossovsky *In its* Geophys. and Astronomy, No. 9 1966 p 3–9 refs (See N68-15376 08-13)

The possibility of informational analysis of geophysical data is discussed. Formulas are presented for computing the amount of information supplied by geophysical measurements. Author

N68-15378# Dnepropetrovsk F. A. Artem Mining Inst. (Ukrainian SSR).

DETERMINATION OF THE BEDDING DEPTH OF THE LOWER BOUNDARY OF THE LIKHMAN STRUCTURE OF KRIVOI ROG BASIN

M. V. Kopnin and V. M. Pelyushenko *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 10–13 refs (See N68-15376 08-13)

A method is described for determining the bedding depth of the lower boundary of the iron ore basin from gravitational measurements carried out at different vertical levels in mine workings. Author

N68-15379# Dnepropetrovsk F. A. Artem Mining Inst. (Ukrainian SSR).
USE OF REFRACTED TRANSVERSE AND BODY WAVES IN THE STUDY OF TECTONIC SHEAR ZONES
M. I. Borodulin *In* Akad. Nauk URSR Geophys. and Astronomy. No. 9 1966 p 14–17 ref (See N68-15376 06-13)

The use of the waves at a prospecting depth of 2–5 km yields a more reliable determination of the tectonic structure model and more precise quantitative constructions along longitudinal waves. Author

N68-15380# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
THREE-COMPONENT MEASUREMENTS OF AMPLITUDES AND SEISMIC VELOCITIES
V. P. Rudnitsky *In its* Geophys. and Astronomy. No. 9 1966 p 18–23 refs (See N68-15376 06-13)

Measurements of the arrival intensities of principal waves in boreholes by vertical and horizontal seismic pick-ups permit highly accurate subdivision of the geological section by seismic velocities. The amplitude graphs may be an effective means of investigating media with finely stratified structure and weak differentiation. Author

N68-15381# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
DIFFRACTION AND SCATTERING OF ACOUSTIC WAVES BY A SPHERE PLACED IN A HALF-SPACE
M. A. Lazarenko *In its* Geophys. and Astronomy. No. 9 1966 p 24–28 refs (See N68-15376 06-13)

The problem of the scattering and diffraction of the impulse is solved. The solution was obtained for an elastic liquid medium and a flat incident wave. A way of extending the results is shown. The results are to be applied on studying local objects by seismic methods. Author

N68-15382# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
STUDY OF PROPAGATION VELOCITIES AND QUENCHING OF ELASTIC WAVES IN SEDIMENTARY ROCKS WITH FILTERS DURING EFFECTIVE LOADS
G. I. Petkevich and T. Z. Verbitsky *In its* Geophys. and Astronomy. No. 9 1966 p 29–31 refs (See N68-15376 06-13)

A short description is given of the procedure and basic results of a study of the propagation velocities and quenching of elastic waves. The investigations of rock samples were conducted in a special core-holding bomb, which permitted taking ultrasonic measurements under conditions close to the natural at depths up to 5 km. Author

N68-15383# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
GEOLOGICAL INTERPRETATION OF THE GRAPH OF ACCUMULATION OF DIFFERENCES IN ELEVATIONS ALONG THE PROFILE ZOLOCHEV-LVOV–BATEVO–UZHGOROD
V. I. Somov *In its* Geophys. and Astronomy. No. 9 1966 p 32–35 refs (See N68-15376 06-13)

The results are presented of a geological interpretation of the data of highly precise rerunning of leveling along the regional profile. The determined differentiation of recent movements is affected by the block structure of the investigated area. The available data corroborate the existence of deep contact zones, along which vertical movements of the block occurred. Author

N68-15384# Dnepropetrovsk F. A. Artem Mining Inst. (Ukrainian SSR).
ON THE INTERCONNECTION OF GRANITOID MASSIFS OF THE AZOV AREA (ACCORDING TO GEOPHYSICAL DATA)
P. S. Karmazin *In* Akad. Nauk URSR Geophys. and Astronomy. No. 9 1966 p 36–39 (See N68-15376 06-13)

The data of detailed magnetometric and gravimetric surveys show that the Kalmius and Yelanchik massifs constitute a single body consisting of granosyenites and granites. Massifs of alkaline earth composition (South Kalchik and Oktyabr) consist chiefly of syenites. An analysis of the physical fields indicates that all massifs join at a depth under the enclosing rocks, forming a single body. Author

N68-15385# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
DETERMINATION OF THE STRUCTURAL CHARACTERISTICS OF A PORE SPACE
I. A. Kapkanshchikova *In its* Geophys. and Astronomy. No. 9 1966 p 40–42 (See N68-15376 06-13)

The connection of the structural characteristics with the collector properties and the geophysical parameters is considered. An attempt is made at classification of collectors by various values of the structural characteristics. A statistical approach is made to the study of the microstructure with the aid of averaged parameters of a random characteristic function. Author

N68-15386# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
ON THE MAGNITUDE OF THE HEAT FLOW IN THE OUTER ZONE OF THE FORECARPATHIAN FOREDEEP
R. I. Kutas *In its* Geophys. and Astronomy. No. 9 1966 p 43–47 refs (See N68-15376 06-13)

The results are presented of a determination of the heat flow on the basis of temperature measurements in a borehole and determination of the thermal conductivity of the rocks in the laboratory. The heat flow in the upper strata of the earth's crust undergoes considerable change due to the conditions of heat transfer. In the investigated area the most perceptible perturbation of the heat flow is evoked by the bedding conditions of rocks with different heat conductivities. Author

N68-15387# Akademiya Nauk URSR. Kiev. Inst. of Geophysics.
APPLICATION OF DATA ON THE NATURAL RADIOACTIVITY OF ROCKS ON CONSTRUCTING A TECTONIC SCHEME OF THE UKRAINIAN SHIELD
Y. G. Gerasimov *In its* Geophys. and Astronomy. No. 9 1966 p 48–53 refs (See N68-15376 06-13)

The high mobility of hexovalent uranium and the low mobility of tetravalent thorium give rise to their different behavior under supergenic conditions. Uranium is leached from the rocks in the oxidation zone and is concentrated in the depressed areas with a reduction regime, and thorium is mechanically transported to clastic rocks. The nature of the distribution is not essentially altered during subsequent metamorphosis of the rocks. A number of tectonic blocks in the Ukrainian shield can be traced by the nature of the radioactivity fields of the crystalline rocks. Author

N68-15388# Akademiya Nauk URSR. Kiev.
THE FIRST KARSTOLOGICAL AND GEOPHYSICAL STUDIES OF THE CRIMEAN FOOTHILL REGION
B. N. Ivanov, P. V. Progrushchenko, and Y. I. Shutov *In its* Geophys. and Astronomy. No. 9 1966 p 54–60 refs (See N68-15376 06-13)

The results are considered of comprehensive field explorations of the bowl of the Novoulyanovsk reservoir, located in limestone-marl deposits of the Upper Cretaceous in the zone of the Crimean foothills. While there is no surface karsting in the explored area and in the zone as a whole, the possibility of depth selective karsting is established on the basis of systems of fissure-karst cavities

detected by geophysical methods. Comprehensive geophysical researches are, therefore, considered obligatory in explorations in areas of occurrence of karsting carbonate of the Upper Cretaceous. Author

N68-15389# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.
SOME RESULTS OF THE QUANTITATIVE INTERPRETATION OF THE DATA OF MAGNETO-TELLURIC PROBING ALONG THE YAGOTIN–BATURIN PROFILE
V. K. Amirov *In its* Geophys. and Astronomy, No. 9 1966 p 61–68 refs (See N68-15376 06-13)

The results are presented of an approximate quantitative interpretation of magnetotelluric probing curves. These results are compared with seismic data. Author

N68-15390# Dnepropetrovsk F. A. Mining Inst. (Ukrainian SSR).
RECENT TECTONIC UPLIFT OF THE NORTHERN SLOPES OF SIBERIA AND THE CHUKOTA PENINSULA
M. V. Stovas *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 69–72 refs (See N68-15376 06-13)

Level measurements on the coast of the Karsk, Laptyev, East Siberian and Chukotka seas, despite the shortness of the series (10–15 years), show uneven uplift of the vast area of the northern slopes of Siberia and the Chukotka peninsula, the beginning of which occurred 12–15 thousand years ago, i.e. on the border of the Pleistocene and Holocene. Author

N68-15391# Dnepropetrovsk F. A. Mining Inst. (Ukrainian SSR).
RECENT ASCENDING MOVEMENT OF THE OCEAN LEVEL IN THE EQUATORIAL ZONE
M. V. Stovas *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 73–79 refs (See N68-15376 06-13)

An analysis of level measurements of stations located in the equatorial zone of the Atlantic, Pacific, and Indian Oceans indicates predominance of the ascending movement of the ocean level, which is corroborated by geomorphological investigations. Author

N68-15392# Akademiya Nauk URSR, Kiev.
ON THE ORIGIN OF THE THREE RIDGES OF THE CRIMEA MOUNTAINS
S. V. Albov *In its* Geophys. and Astronomy, No. 9 1966 p 80–83 refs (See N68-15376 06-13)

Tectonic factors (fractures) with superimposed denudation phenomena underlie the formation of all three ridges. Evidently, the longitudinal fractures along the second and third mountain ridges of the Crimea rim the entire Crimean mountain structure on the north, separating it from the plain. Author

N68-15393# Akademiya Nauk URSR, Kiev.
NEW DATA ON THE ABYSSAL STRUCTURE OF THE CENTRAL PART OF THE MAIN CRIMEAN RIDGE
I. P. Boiko, I. N. Vasilyev, A. P. Zadorozhnaya, and P. E. Melnik *In its* Geophys. and Astronomy, No. 9 1966 p 84–88 refs (See N68-15376 06-13)

A geoelectrical characterization is presented of the Yalta and eastern Ai-Petri mountain massifs, the structure of the lower stage (water-resistant base) is briefly described, and a more detailed characterization is given of the upper stage, composed of carbonate karsting rocks of the Upper Jurassic. On the basis of data of geophysical and geological exploration the characteristics are given of the geological structure and the peculiarities of the hydrogeology of a large section of the main Crimean ridge. Author

N68-15394# Akademiya Nauk URSR, Kiev.
ON THE LOWER PLATEAU OF THE MAIN CRIMEAN RIDGE
S. Y. Albov *In its* Geophys. and Astronomy, No. 9 1966 p 89–90 refs (See N68-15376 06-13)

On the northern slope of the main Crimean ridge there is a lower plateau, separated from the summits by a steep scarp. The plateau and the scarp rising up above it on the south were formed by the Lower Cretaceous sea. Author

N68-15395# Akademiya Nauk URSR, Kiev.
ABYSSAL FRACTURES OF THE SOUTH OF THE UKRAINE
G. E. Kharechko *In its* Geophys. and Astronomy, No. 9 1966 p 91–97 refs (See N68-15376 06-13)

A study of the fracture tectonics of the southern Ukraine permits grouping the observed tectonic zone in a submeridional and a sublatitudinal system, identifying some of them as zones of abyssal fracture and determining their type. Abyssal fracture zones are informative for the detection of various ore deposits. Author

N68-15396# Akademiya Nauk URSR, Kiev.
STRUCTURE OF THE FOUNDATION OF THE SOUTHWESTERN MARGIN OF THE RUSSIAN PLATFORM ACCORDING TO GEOPHYSICAL DATA
M. S. Yarish, M. D. Buderkevich, and Kh. B. Zayats *In its* Geophys. and Astronomy, No. 9 1966 p 98–104 refs (See N68-15376 06-13)

New data are presented on regional seismic investigations within the southwestern margin of the Russian platform, which permit refining the tectonic structure of this region. The very distinct tectonic separation of the western slope of the Ukrainian shield and the Lvov paleozonic trough is pointed out. The conclusions drawn agree with the data obtained by other geophysical methods. Author

N68-15397# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.
SOME REGULARITIES OF THE APPEARANCE OF OSCILLATIONS WITH PERIODS UP TO 10 SEC IN THE EARTH'S ELECTROMAGNETIC FIELD
F. I. Sedova *In its* Geophys. and Astronomy, No. 9 1966 p 105–109 refs (See N68-15376 06-13)

The results are presented of observations of micropulsations at the terrestrial current station in Korets in 1958–1964. Statistical correlation is observed in the occurrence of oscillations of the type Pc-1 (0.2–5 sec) and Pc-2 (5–10 sec). Author

N68-15398# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.
ON THE INTERMEDIATE IONOSPHERE LAYERS E2 AND FO
A. G. Kasymova *In its* Geophys. and Astronomy, No. 9 1966 p 110–123 refs (See N68-15376 06-13)

The morphology of the intermediate E2 and FO layers is studied by the data of several stations situated in both hemispheres. The diurnal, seasonal, and latitudinal variations of probability of the appearance of E2 and FO layers and their electron densities are given. The duration of reflection from E2 and FO layers, their magnitudes, and dependence of PE2, PFO, foE2, and foFO on solar activity are discussed. Author

N68-15399# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.
ON THE NATURE OF THE INTERMEDIATE IONOSPHERE LAYERS E2, FO, F1.5
A. G. Kasymova *In its* Geophys. and Astronomy, No. 9 1966 p 124–129 refs (See N68-15376 06-13)

The correlation between the appearance of intermediate ionosphere E2 and FO layers and other geophysical phenomena is discussed, and the opinion is advanced that E2 and FO are separate layers. Author

N68-15400# Akademiya Nauk URSR, Kiev. Marine Hydrophysical Inst.

PRELIMINARY RESULTS OF A STUDY OF MOTIONS OF SMALL-SCALE INHOMOGENEITIES IN THE LOWER IONOSPHERE IN THE VICINITY OF THE COASTAL LINE OF THE BLACK SEA

N. N. Karnaushenko *In its* Geophys. and Astronomy, No. 9 1966 p 130–133 refs (See N68-15376 06-13)

The results are presented of a study of the drifts of small-scale inhomogeneities in the El, E_s, and F layers of the ionosphere in the vicinity of coastal temperature contrasts. The period of observations embraces 1964. A preliminary processing of the data by the similitude method and a harmonic analysis reveal predominating drifts of a seasonal and local nature in the ionosphere. The seasonal regularity of the drifts is particularly distinct in the lower layers of the ionosphere. Qualitatively different pictures are obtained for drifts of inhomogeneities in the E and F layers. Author

N68-15401# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.

DURATION OF THE EXISTENCE OF E SPORADIC OVER KIEV

V. I. Bondarenko *In its* Geophys. and Astronomy, No. 9 1966 p 134–136 ref (See N68-15376 06-13)

The stability of existence of the sporadic layer E_s is studied. Data obtained at the ionosphere station Kiev in 1962 were used. A seasonal variation of the stability of E_s was detected, rigorously connected with the seasonal course of probability of its appearance by a direct dependence. The nature of E_s distribution by duration was also found to change from season to season. Author

N68-15402# Akademiya Nauk URSR, Kiev. Inst. of Geophysics.

VARIATIONS OF THE EARTH'S MAGNETIC FIELD IN EQUATORIAL REGIONS

L. N. Yaremenko *In its* Geophys. and Astronomy, No. 9 1966 p 137–144 (See N68-16376 06-13)

Near the magnetic equator, in the regions of action of the equatorial jet current, we observe abnormally large amplitudes of diurnal variations H and partially of Z. Sharp seasonal changes in diurnal amplitudes, considerably exceeding the seasonal variations without the influence of the jet current, are distinctly seen. The amplitudes of the seasonal variations H, are chiefly determined by the magnetic latitude of the observatory and depend to a large extent on the longitude. The highest amplitudes of diurnal variations are recorded in the South American longitudinal zone and in Australasia; considerably less in Africa and India. Asymmetry exists as between the northern and the southern hemisphere, the amplitudes of variations H being higher to the south of the equator than in the northern hemiaphere. Author

N68-15403# Poltava Gravimetric Observatory (Ukrainian SSR).

ON CHANGES IN LATITUDE AND ON THE POSITION OF THE MEDIAN POLE OF THE EARTH

E. I. Obrezkova *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 145–148 refs (See N68-15376 06-13)

The rate and direction of motion of the median pole of the earth are derived from observations of the latitudes of Mizusava, Carloforte, and Yukaia from 1900 to 1935. The results are compared with those of other authors. Author

N68-15404# Poltava Gravimetric Observatory (Ukrainian SSR).

ANALYSIS OF OBSERVATIONS OF THE LATITUDE OF POLTAVA DURING THE IGY AND IYQS IN CONNECTION WITH STUDIES OF ZENITH TELESCOPE LEVELS

Z. I. Obrezkova and I. I. Pilyukh *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 148–152 refs (See N68-15376 06-13)

Determinations are presented of the values of divisions of Talcott levels of the Bamberg zenith telescope, and the results are given of observations of the latitude of Poltava with this instrument according to the program of the basic A and C groups during the IGY and IQSY. It is shown that the new values of the divisions of levels gives better agreement with observations. Author

N68-15405# Kiev Univ. (USSR).

ON THE NATURE OF RESONANCE PHENOMENA DURING SCATTERING OF RADIO WAVES ON METEOR TRACK MODELS

I. V. Bairachenko *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 153–156 refs (See N68-15376 06-13)

The present theories on the nature of plasma resonance are discussed on the basis of experimental data on the resonance scattering of radio waves on meteor trail models. Theories based on the cold plasma model are not confirmed experimentally. An explanation of higher type resonance is given, taking into account the thermal motion of electrons, which from the viewpoint of the physics of occurring processes means the interaction of the incident radiation electric field with plasma waves. Author

N68-15406# Kiev Univ. (USSR).

STATISTICAL CHARACTERISTICS OF METEOR RADIO ECHOES FROM SPORADIC METEORS

E. I. Fialko, R. I. Moiaya, G. I. Kolomiets, V. I. Melnik, and Y. V. Chumak *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 157–161 refs (See N68-15376 06-13)

Statistical characteristics are given for a period of absence of intensive meteor streams according to observations of 29 October 1964. The parameters are determined, and the results are interpreted. Author

N68-15407# Akademiya Nauk URSR, Kiev.

ON THE EFFECT OF THE TWENTY-SEVEN-DAY SOLAR CYCLE ON THE TEMPERATURE FIELD OF THE TROPOSPHERE

R. V. Smirnov *In its* Geophys. and Astronomy, No. 9 1966 p 162–164 refs (See N68-15376 06-13)

The results are presented of an investigation of the geomagnetic activity and temperature of the terrestrial layer of the troposphere by the twenty-seven-day solar calendar. It is shown that there is a tendency towards a twenty-seven-day recurrence on the course of temperature values. This is corroborated by the correlation between the values of the magnetic activity and temperature for several periods of the eleven-year cycle. The reality of the correlation is evaluated statistically. Author

N68-15408# Kiev Univ. (USSR).

ON THE DISTRIBUTION OF METEOR BODIES BY ENERGIES (EXPERIMENT ON $\lambda = 9.59$ m)

E. I. Fialko and I. V. Bairachenko *In* Akad. Nauk URSR Geophys. and Astronomy, No. 9 1966 p 165–169 refs (See N68-15376 06-13)

The distribution of meteors by kinetic energies was derived on the basis of observations conducted on the epoch Geminidae shower of 1963. The energy distribution is of a nature similar to mass distribution. Author

N68-15448*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TRANSFORMATION OF BIOTITE INTO OPAL IN THE SOILS OF NORTHERN KARELIA

Ye. I. Parfenova Oct. 1967 3 p refs Transl. into ENGLISH from Zap. Vses. Mineralog. Obshchestva (USSR), ser. 2, v. 85, 1956 p 585–586
(Contract NAS7-100)
(NASA-CR-92552) CFSTI: HC $3.00/MF $0.65 CSCL 08G

The mineralogical composition of the upper levels of podzolic soils of Northern Karelia is discussed in relation to the transformation of biotite into opal. It is pointed out that the decolorization of biotite, the reduction of its specific gravity, and the lowering of its index of refraction indicate that during the process of soil formation it loses iron for the most part, while its final conversion into opal also indicates the loss of all the elements comprising it except SiO_2 (and apparently part of the aluminum). Experimental data are briefly reviewed to show that microorganisms participate in transformation of the mineral. M.G.J.

N68-15449*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ROLE OF MICROORGANISMS IN THE WEATHERING OF ROCKS. 2: FOCAL DISTRIBUTION OF MICROORGANISMS ON THE SURFACE OF ROCKS
N. A. Krasil'nikov 1967 9 p Transl. into ENGLISH from Mikrobiologiya (USSR), v. 18, no. 6, 1949 p 492–497
(Contract NAS7-100)
(NASA-CR-92523) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Specimens of basalt and red tufa were selected for use in studies on the degree to which rock elements provide mineral nutriment for microorganisms dwelling in the altered surface layer of the rock. The pieces were taken from a central microbe-free part of the monolithic specimens and ground into fine powder. Experimental details are given, and tabulations show the growth of microorganisms in a synthetic medium with rock as the mineral nutrient source, along with the qualitative characteristics of such microorganisms. The results establish: (1) Microorganisms grow better on basaltic rocks than on a medium with tufa. (2) Bacteria and mycobacteria undergo the greatest development in media with rocks; actinomycetes and fungi are considerably more feeble in their growth. (3) The overgrowth of rocks by lichens and other microorganisms is a focal process. M.G.J.

N68-15483# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE SOLAR WIND AND POLAR AURORAE [SOLNECHNYY VETER I POLYARNYYE SIYANIYA]
V. I. Krasovskiy 18 Jul. 1967 18 p Transl. into ENGLISH from Priroda (Moscow), no. 5, 1966 p 14–20
(FTD-HT-23-795-67; AD-662242)

The author analyzes some similarities in the origin of comets and aurorae, with emphasis on light radiation and solar corpuscular radiation, compares the tails of comets with that of the earth, and finds similarities in their formation. TAB

N68-15491# Sandia Corp., Albuquerque, N. Mex.
CRATER, EJECTA, AND AIR BLAST STUDIES FROM FIVE HIGH-EXPLOSIVE CHARGES IN A HORIZONTAL SQUARE ARRAY
C. Annette Rappleyea Apr. 1967 159 p refs
(Contract AT(29-1)-789)
(SC-RR-66-480) CFSTI: HC $3.00/MF $0.65

Fifteen shots, each consisting of five 64-pound spherical charges of cast TNT buried at depths of 6, 8, or 10 feet, were detonated in dry-lake playa at the Tonopah Test Range. Charges were arranged in a horizontal square array with the fifth charge in the middle and with spacings on the side of the square ranging from 8 to 18 feet. One shot using five 8-pound charges and one using five 256-pound charges were fired at the same cube-root scaled burial depths and spacings as one of the shots using a 64-pound charge. Crater dimensions, air blast, ejecta areal distribution, and permanent displacement of the ground surface were measured. The apparent crater volume for the five 64-pound charges was about three times that from a single 320-pound charge detonated at the same depth. The apparent crater radius from five 64-pound charges was 1.5 times that from a single 320-pound charge. Peak overpressures were as much as 1/10 those for a single 320-pound charge at the same burial depth. A distinctive ejecta pattern showed four mounds formed along the flat sides of the square containing amounts of ejecta that varied with depth of burst. Permanent ground motion was irregular but showed a net inward radial motion in many cases. Author (NSA)

N68-15510# RAND Corp., Santa Monica, Calif.
MID-LATITUDE VERTICAL TRANSMISSION OF GEOMAGNETIC MICROPULSATIONS THROUGH THE IONOSPHERE
Phyllis S. Greifinger Nov. 1967 69 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(RM-5099-ARPA; AD-663269)

The report includes a theoretical description of the transmission of extremely low-frequency (below a few cps) geomagnetic waves propagating vertically through the ionosphere at middle and high latitudes, either naturally or as a result of a nuclear burst. The principal findings of the study are given. TAB

N68-15543# Texas Univ., Austin. Labs. for Electronics and Related Science Research.
SPACE, ATMOSPHERIC, AND EARTH RADIO SCIENCES
In its Tex. Biann. of Electron. Res. 15 Nov. 1967 p 204–214 refs (See N68-15539 06-10)
(Grant NGR-44-012-048; Contracts AF 19(628)-4046; Nonr-375(14); DA-49-092-ARO-87; Nonr-4690(00))

Propagation of low frequency electromagnetic and hydromagnetic waves in the magnetosphere, ionosphere, atmosphere, and earth is summarized; and magnetotellurics determination of subsurface resistivities and a least squares approach to fitting magnetotelluric data with layered models are discussed. Flight characteristics of insects are compared with observed characteristics of radar dot angles, and characteristics of atmospheric refractive index differences are presented. A bistatic radar was designed to measure in-cloud drop size distribution function, a giant pulse ruby laser was used to stimulate Raman emission, and a radar was designed for studying atmospheric turbulence. Axisymmetric stress wave propagation across the plane interface between two cylindrically bounded media is described. M.W.R.

N68-15565# Los Alamos Scientific Lab., N. Mex.
THE 1965 ARPA-AEC JOINT LIGHTING STUDY AT LOS ALAMOS, VOLUME 1
T. Robert Connor 5 Dec. 1967 34 p refs
(Contract W-7405-ENG-36; ARPA Order 631)
(LA-3754, V. 1; AD-663136)

The visible energy radiated (3900 to 6900 A) per unit of length of lightning channel was calculated using time- and wavelength-integrated spectrographic data of the 1965 lightning study. An estimated rain-transmission correction was used. The total energy deposition was calculated, assuming a dipole model of a lightning stroke and using measured values of charge transferred and channel length. The efficiency for conversion of electrical energy to visible radiation is found to be 0.007 plus or minus 36%. Author (TAB)

N68-15627# Space Instruments Research, Inc., Atlanta, Ga.
UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (YUMA, 16–19 NOVEMBER 1966)
Marvin Anthony Jun. 1967 91 p refs
(Contract DA-01-009-AMC-169(X))
(BRL-6; AD-662719)

On the night of 18-19 November 1966, seven luminous trails were produced between 85km and 167km by the release of tri-methyl-aluminum from projectiles fired from a smoothbore sixteen-inch gun located at Yuma Proving Ground, Arizona (114.2 degrees W, 32.8 degrees N). Two additional sets of four trails each were produced on the nights of 16-17 November 1966 and 19-20

November 1966. These trails were photographed by cameras located at Yuma and Gila Bend in Arizona and at Blythe, California and have been analyzed to yield wind profiles. The report contains the tabulated wind data for all fifteen trails together with plots versus altitude of wind components, wind speed, and wind heading. Author (TAB)

N68-15628# Naval Oceanographic Office, Washington, D. C.
THE PROBLEM OF HISTORICAL HYDROLOGY OF SEAS AND OCEANS [PROBLEMY ISTORICHESKOY GIDROLOGII MOREY I OKEANOV]
M. M. Yermolayev 1967 28 p Transl. into ENGLISH from Vopr. Geogr. Klimatologiya i Gidrolog. (Moscow), v. 7, 1948 p 27–36
(NOO-TRANS-346; AD-662265)

The general pattern of Kara Sea sediments is analysed by comparing bottom cores obtained in various sectors of the sea. This pattern and the chemical characteristics of the sediments are discussed in connection with the influx of Atlantic Water from the west and fluvial water from the south. The stratification of the sediments is compared with those in the surrounding areas--the Barents, and Greenland Seas. Thus certain generalized conclusions are drawn with regard to geological and hydrological changes that have occurred in the past, which call for a new approach in the study of sedimentation in seas--namely, the application of hydrochemical and magnetic methods in order to obtain a clearer concept of the complex sedimentation processes. Author (TAB)

N68-15651# Martin Co., Baltimore, Md. Research Inst. for Advanced Studies.
MEASUREMENT OF GEO-ELECTRIC FIELDS AND UPPER ATMOSPHERE PARAMETERS BY RELEASE OF BARIUM VAPORS Final Report
James B. Mead, Ed M. Parkison, and Louis Witten Nov. 1967 76 p refs
(Contract DAA05-67-C-0142)
(RIAS TR-67-17C; AD-662066)

The document is a final report covering the development of a barium release payload and fusing system suitable for launch from the extended 16-inch gun facility of project HARP. The objective of this program was the performance of several experiments to measure various parameters important to the understanding of ionospheric processes. These included ambient electric fields, wind velocities, and diffusion coefficients. The experiments involved the release of a quantity of barium vapor aloft at altitudes between 140 Km and 200 Km and the subsequent measurement of motions of the resulting clouds using data acquired from ground-based camera stations. A detailed description of various tests and conclusions related to the performance of such a payload are given. Also included are details of an observation program designed to extract optimum data from the ground-based measurements. Two specially designed HARP vehicles (Martlet 2c), complete with nominal 200 sec. fusing systems, were loaded with 22 lbs. of barium-copper oxide thermite and delivered to the HARP launch site at Yuma Proving Ground. Following the onset of serious problems with the Yuma gun, the payloads were then shipped to Barbados for subsequent launch. After failure of the Barbados gun, the decision was made by APG to delay the launch of these payloads beyond the term of the existing contract. Author (TAB)

N68-15690# Space Instruments Research, Inc., Atlanta, Ga.
UPPER ATMOSPHERE WINDS FROM GUN LAUNCHED VERTICAL PROBES (BARBADOS, FEBRUARY 17–25, 1966)
Robert N. Fuller Jan. 1967 54 p refs
(Contract DA-01-009-AMC-169(X))
(BRL-5; AD-662718)

On the night of 23-24 February 1966, six luminous trails were produced between 87km and 131km by the release of tri-methyl-aluminum from projectiles fired from a smoothbore sixteen-inch gun located on the West Indian island of Barbados (57.5 degrees W, 13.1 degrees N). Single trails were also produced on the nights of 17 February 1966 and 25 February 1966. These trails were photographed from neighboring islands and analyzed to yield wind profiles. The report contains the tabulated wind data for all eight trails together with plots versus altitude of wind components, wind speed, and wind heading. Author (TAB)

N68-15691# Osservatorio Geofisico Sperimentale, Trieste (Italy).
FINAL RESULTS OF CAMBRIDGE AND CGI PENDULUM MEASUREMENTS Scientific Report
Carlo Morelli 28 Feb. 1967 206 p refs
(Contract AF 61(052)-656)
(AFCRL-67-0524; SR-1-A; AD-662583)

Pendulum measurements taken with the Cambridge and Italian Geodetic Commission (CGI) apparatus are presented. After a short summary of the problems involved with the First Order World Gravity Net and the Standardization, the pendulum measurements are introduced with a general presentation of the actual situations of the observations with various apparatus that can be employed in the modern adjustments of the worldwide scale. The pendulum station descriptions and a summary of in-centre reductions are also presented. Three separate Annexes cover the Cambridge pendulum observations taken in 1963-64 on the EACL and NACL; the CGI measurements in Europe and Africa 1963-64 and the 1965 measurements in America. The accuracy, deduced from an internal basis, is about plus or minus 0.2 mGal for the Cambridge pendulums, while the CGI pendulums gave poor results in Africa and America: their employ will therefore be subject to further investigations (on statistical basis) to evaluate the obtainable contribution in the final adjustment. Author (TAB)

N68-15714*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
WIND COMPARISON ANALYSIS OF PIBAL VERSUS ANEMOMETER
Michael Susko 17 Oct. 1967 26 p refs
(NASA-TM-X-53663) CFSTI: HC $3.00/MF $0.65 CSCL 04A

The differences of lower atmosphere wind velocities obtained by a mast-mounted anemometer and 10-gram pilot balloons (pibals) are discussed. Wind velocity measurements were made by an anemometer mounted at the 15.24 meter level on a mast; whereas, simultaneous wind measurements were calculated from time referenced pibal photographs taken as the pibals passed the anemometer. The absolute value of the mean difference in wind speed is 0.53. m sec^{-1} whereas the RMS value is 0.62 m sec^{-1}. The absolute value of the mean difference in wind direction is 4.9 degrees, while the RMS value is 5.6 degrees. Author

N68-15718# Naval Oceanographic Office, Washington, D. C.
PERMANENT CURRENTS OF THE NORTHERN BARENTS SEA [POSTOYANNYYE TECHENIYA SEVERNOY CHASTI BARENTSEVA MORYA]
V. P. Novitskiy 1967 32 p refs Transl. into ENGLISH from Tr. Gos. Okeanogr. Inst. (Leningrad), v. 64, 1961 p 1–32
(NOO-TRANS-349; AD-663027)

The paper substantiates a new scheme of permanent currents in the northern Barents Sea. In addition, new concepts are discussed on the basic factors which determine the general circulation of water in the Barents Sea, the effect of permanent currents on the distribution of ice during the warm season of the year, and a preliminary analysis of the effect of the Deep Atlantic Water on the distribution of ice in winter. Data of the last several years enables us to supplement and refine the existing general picture of the hydrology of the northern Barents Sea. This has previously been based on scant data and, as a result, contained unreliable and contradictory statements, and conclusions. This explains that differences between the existing schemes of permanent currents and between the schemes of currents based on the latest temperature, salinity and hydrochemical data. Hence, this circumstance called for a new scheme of permanent currents. Author (TAB)

N68-15731# Naval Weapons Lab., Dahlgren, Va. Computation and Analysis Lab.
A STRETCH COMPUTER PROGRAM TO CALCULATE THE GRAVITATIONAL POTENTIAL OF THE EARTH AS A SUM OF SOLID HARMONICS
Rannie W. Royal Nov. 1967 24 p ref
(NWL-K-68/67; AD-663106)

A detailed description, including flow charts, derivations of equations, input and output configurations, and FORTRAN IV program listing, is given for an IBM 7030 computer subprogram used to obtain the gravitational potential of the earth from a variable number of spherical harmonics. Author (TAB)

N68-15737# Naval Radiological Defense Lab., San Francisco, Calif.
HIGH TEMPERATURE MEASUREMENTS OF THE RATE OF UPTAKE OF TeO_2 VAPOR BY SELECTED OXIDES
Charles E. Adams, William R. Balkwell, and Jack T. Quan 26 Sep. 1967 57 p refs Supported in part by DASA
(Contract AT(49-7)-1963)
(USNRDL-TR-67-134; AD-663267)

In a program for elucidation of the process of formation of radioactive fallout, the rates at which substrate samples of calcium ferrite and of clay loam took up vaporized TeO2 were measured. The rate measurements were made for uptake in air from 900 to 1500C and over a TeO2 partial-pressure range of about 0.0000005 to 0.0002 atm. It was found that the rate of uptake of TeO2 by the calcium ferrite was two to three orders of magnitude faster than the rate of uptake by the clay loam. The rate-controlling process for the uptake of TeO2 by the calcium ferrite was the diffusion of the TeO2 vapor molecules through the air. No unique rate-controlling process was found for the uptake of TeO2 vapor by the clay loam. In this system, the rate seemed to be controlled both by a slow rate of reaction of the TeO2 at the clay loam surface and by the slow diffusion of the condensed TeO2 into the clay loam. Author (TAB)

N68-15744# Naval Oceanographic Office, Washington, D. C.
THE PRINCIPLE OF DIVIDING ABSOLUTE (GRAVIMETRIC) DEVIATIONS OF PLUMB LINE INTO LOCAL AND GENERAL (PLANETARY) TILTS [PRINTSIP RAZDELENIYA ABSOLYUTNYKH (GRAVIMETRICHESKIKH) UKLONENIY OTVESA NA MESTNYYE I OBSHCHIYE (PLANETARNYYE)]
V. V. Buzuk 1967 6 p refs Transl. into ENGLISH from Tr. Novosibirsk. Inst. Inzh. Geod., Aerofotos Yemki i Kartografii, vol. 18, no. 1, 1964 p 9–13
(TRANS-356; AD-662374)

An acceptable determination of the factoring coefficient of anomalies of gravity force to the eighth order, inclusively, makes it possible to divide the anomalies of gravity force, heights of qussigeoid and deviations of plumb line into two parts: local and planetary. Such a division is of special significance for advanced geodesy because it enables one to calculate the absolute deviations of plumb line at any point on the Earths surface with a sufficiently accurate specification of the effect of far zones and, undoubtedly, is of interest for the physics of the Earth because it enables one to single out of the observed anomalies of gravity force the planetary anomalies that are caused by the considerable irregularities in the structure of the Earths crust. TAB

N68-15758*# Ohio State Univ. Research Foundation, Columbus.
DATA ANALYSIS IN CONNECTION WITH NATIONAL GEODETIC SATELLITE PROGRAM
Ivan I. Mueller Nov. 1967 30 p
(Contract NSR-36-008-033)
(NASA-CR-91658; Rept.-93) CFSTI: HC $3.00/MF $0.65 CSCL 08E

Programming, testing, debugging, and analysis methods; operational procedures for tracking, communications, and data formats; and determining relative positions of observation stations are among the activities related to the data analysis for the National Geodetic Satellite Program. Geometric analysis of geodetic satellite data is reported in terms of planned geodetic networks, optical and nonoptical data, formation of normal equations for optical and range observations, and the formulation and computer program for the solution of these normal equations. M.W.R.

N68-15764*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECT OF MICROORGANISMS ON PROCESSES OF WEATHERING PRIMARY MINERALS
M. A. Glazovskaya 1967 31 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Pochv. (USSR), no. 6, 1950 p 79–100
(Contract NAS7-100)
(NASA-CR-92525) CFSTI: HC $3.00/MF $0.65 CSCL 08D

A study of the effects of microflora and microorganisms on weathering processes of primary minerals and the synthesis of secondary new formations is reported. Studied were minerals containing various mineral elements necessary to microorganism survival. Orthoclase, muscovite, and biotite were used as the potassium source; biotite and serpentine, as the magnesium source; apatite, as the source of phosphorus; and pyrite as the sulfur containing mineral. Two specimens of granite were also studied. Results indicated that: (1) Microorganisms living on rocks may use primary minerals as sources of elements necessary to life. (2) In the process of microorganism growth, the minerals are decomposed and new minerals and organic materials are formed; and diverse groups of microorganisms, such as fungi, bacteria, diatom algae, and green and blue green algae participate in the processes of decomposition and secondary synthesis. (3) Based on their degree of susceptibility to the destructive action of microorganisms, the minerals and rocks studied may be arranged in the following descending series: muscovite, biotite, orthoclase, and graphite. S.C.W.

N68-15767*# Stanford Univ., Calif. Remote Sensing Lab.
STATISTICAL ANALYSIS OF IR SPECTRA—STANFORD PROGRAMS APPLIED TO USGS SPECTRA IN TECH LETTER NO. 13
10 Nov. 1967 108 p refs
(Grant NGR-05-020-115)
(NASA-CR-92594; RSL-TR-67-3) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Infrared emittance spectra (8–14 microns) of 13 rock samples from the Pisgah Crater and Mono Craters test sites have been published. The samples include felsic plutonic and volcanic rocks from Mono Craters and mafic volcanic rocks from Pisgah Crater. The 13 spectra were taken of heated samples with a Block Engineering Model I-4T interferometer spectrometer equipped with an ambient temperature thermistor bolometer detector. We have digitized the 13 spectra by hand at a 0.1 micron interval from 7.8 to 13 microns and statistically analyzed the data according to our now, fairly routine algorithms. We have prepared secondary entry points in the LMSC CORRCO program so that spectral emittance ratios taken from other sources can be used and compared against our library of 19 rocks in the memory of the computer. Author

N68-15809*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MICROFLORA OF HIGH ALTITUDE ROCKS AND ITS NITROGEN FIXING ACTIVITY
N. A. Krasil'nikov 1967 20 p refs Transl. into ENGLISH from Usp. Sovrem. Biol. (USSR), v. 41, no. 2, 1956 p 177–192
(Contract NAS7-100)
(NASA-CR-92553) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Studies of lichens and free-living microorganisms growing on rocks of mountain tops devoid of higher vegetation are reviewed. Lichens, bacteria, actinomycetes, fungi, and algae were identified in the weathered crusts of the Pamirs, central Tien Shan peaks, Ural Mountains, and the high peaks in Soviet Armenia. The

nitrogen fixation of oligonitrophyll bacteria was studied, and it is concluded that nitrogen fixation takes place on the mountain tops to a much greater degree than in the valleys, and that the nitrogenous compounds are washed out by waters and are carried away into the valleys. N.E.N.

N68-15812*# National Aeronautics and Space Administration, Washington, D. C.
GEOLOGY OF THE USSR. VOLUME 31: KAMCHATKA, KURIL, AND KOMANDORSKIYE ISLANDS. PART 1: GEOLOGICAL DESCRIPTION
G. M. Vlasov, ed. Dec. 1967 827 p refs Transl. into ENGLISH of the book "Geologiya SSSR, Tom 31, Kamchatka, Kuril'skiye i Komandorskiye Ostrova. Chast' 1, Geologicheskoye Opisaniye" Moscow, Izd. Nedra, 1964
(NASA-TT-F-11529) CFSTI: HC $3.00/MF $0.65 CSCL 08G

Extensive data are presented from geological investigations through 1961. Area boundaries are: 44:61N and 146:164E, extending meridionally for 1900 km. Topics covered for the three areas under study include: physiographic description and economics, basic geological features and zoning, stratigraphy, magmatism and metamorphism, tectonics, geomorphology, and geological development history. Since Kamchatka and the Kuril and Komandorskiye Islands are situated along the waters of the Pacific and inland seas, material is presented describing the tectonic and geomorphological features of adjacent sea bottoms. E.C.

N68-15820# Naval Oceanographic Office, Washington, D. C.
LITHOGENESIS OF PLASTIC CLAY SEDIMENTS IN SEAS [O LITOGENEZE PLASTICHESKIKH GLINISTYKH MOSKIKH OSADKOV]
M. M. Yermolayev 1967 13 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser., Geofiz. (Moscow), no. 1, 1948 p 121–138
(NOO-TRANS-355; AD-662264)

The initial stage of lithogenesis of marine clay sediments is discussed. A special Atlantic type of bottom of the Arctic Eurasian seas is singled out. The distribution of chemical elements in the sediments is described. The concept of nonuniform lithogenesis is defined. The connection between the process, the life of microorganisms and hydrological regime in the water basin is established. The latter leads to conclusions on large-scale changes in the Kara Sea regime during the recent past. On the basis of the distribution of manganese and radium, the absolute speed of sedimentation and the stability of the variations occurring in the bottom during the first stages of lithogenesis is determined. Author (TAB)

N68-15825*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE ROLE OF MICROORGANISMS IN THE WEATHERING OF ROCKS. 1: MICROFLORA OF THE SURFACE LAYER OF ROCKS
N. A. Krasil'nikov Oct. 1967 7 p refs Transl. into ENGLISH from Mikrobiologiya (Moscow), v. 18, no. 4, 1949 p 318–323
(NASA-CR-92538) CFSTI: HC $3.00/MF $0.65 CSCL 08D

Microbiological analyses were conducted on the altered surfaces of basalt, granite, tufa, and limestone. The surfaces were mechanically freed of lichens, flushed, and washed in sterile water to cleanse them of surface microorganisms. The findings indicate: (1) The layer is inhabited by a great number of organisms. The majority consist of bacteria and myco-bacteria with considerably fewer fungi and actinomycetes. (2) A larger number of microorganisms are found in the surface layer of basalt, granite, and limestone than in tufa. (3) Free-living algae are detected in relatively great quantities on rocks not overgrown with lichens, and are seemingly necessary concomitants to bacterial and fungous flora. (4) In their biological characteristics, the bacteria or rocks are unique, differ from the ordinary forms, and belong chiefly to the autotrophs developing on synthetic media with mineral sources of nitrogen. It was concluded that these bacteria, together with free-living algae are the first settlers on the original virgin rocks, and prepare the soil for lichens and other organisms. Author

N68-15842# Naval Oceanographic Office, Washington, D. C.
ATLAS OF HYDROLOGICAL CHARACTERISTICS OF THE NW PART OF THE BLACK SEA [ATLAS GIDROLOGICHESKIKH KHARAKTERISTIK SEVERO-ZAPADNOY CHASTI CHERNOGO MORYA]
K. A. Vinogradov, M. Sh. Rozengurt, and D. M. Tolmazin 1967 96 p Transl. into ENGLISH from Naukovaya Dumka (Kiev), 1966 p 1–14
(NOO-TRANS-362; AD-663029)

The atlas consists of 79 charts illustrating the hydrological characteristics (temperature and salinity at surface and bottom, as well as transparency) in the NW part of the Black Sea during the fishing period (from April to October). Also the positions of hydrological fronts are shown in the Dnepr, Dnestr, and Danube estuary areas. The charts showing the surface water temperature indicate the concentrations of schools of fishes which are more or less stable from one year to the other as well as the migration routes of the major commercial fishes. The atlas is designed for use by ichthyologists, hydrobiologists, and hydrologists. Author (TAB)

N68-15845# Aeronautical Chart and Information Center, St. Louis, Mo. Linguistic Section.
APPLICATION OF A UNIVERSAL STEREOPHOTOGRAMMETRIC APPARATUS OF THIRD ORDER ACCURACY (SANTONI STEREOMICROMETER) IN STUDYING THE FISSURE TECTONICS OF AN INTRUSIVE MASS [PRIMENENIYE UNIVERSAL'NOGO STEREOFOTOGRAMMICHESKOGO PRIBORA 3-GO KLASSA TOCHNOSTI (STEREOMIKROMETRA SANTONI) PRI IZUCHENII TRESHCHINNOY TEKTONIKI INTRUZIVNOGO MASSIVA]
M. M. Nabokov, V. I. Narkevich, Ye. Ye. Rozhko, and I. A. Cherkasov Oct. 1967 20 p refs Transl. into ENGLISH from the Publ. "Fotogrammetricheskaya Obrabotka i Deshifrovaniye Aerosnimkov" (Leningrad), Nauka, 1967 p 139–148
(ACIC-TC-1292; AD-662286)

The article describes one of the variants of the new technology of compilation of large-scale geological maps. One section of this article deals with the description of the technological process of construction of geological sketch maps with the aid of universal stereophotogrammetric instruments. The methods of graphic-analytical determination of the occurrence elements, and the possibilities of the diffraction method of analysis of the fissure lattices are described. The methods of office interpretation, the geological description of the object and the results of the field control of the compiled map are presented. Author (TAB)

N68-15862# Naval Oceanographic Office, Washington, D. C.
SOME CHARACTERISTICS OF THERMICS AND CURRENTS OF THE SEA OF JAPAN [O NEKOTORYKH OSOBENNOSTYAKH TERMIKI I TECHENIY YAPONSKOGO MORYA]
A. K. Leonov 1967 29 p refs Transl. into ENGLISH from Izv. Vsesoyuznogo Geog. Obshchestva (Leningrad), v. 90, no. 3, 1958 p 244–264
(Rept.-358; AD-663028)

The currents and their effect on water temperature in various parts of the Sea of Japan are analyzed in detail. Special attention is paid to the evaluation of a view expressed by Shrenk in 1874. According to it, the northern Sea of Japan is cooled by the cold Limanskoye Current which flows from the Sea of Okhotsk through proliv Nevelskogo; whereas the Sakhalin coast is warmed by the Japanese Current. In order to evaluate the situation, the entire current system of the Sea of Japan is discussed by using all of the

available hydrological data. It appears that the effect of the Liman Current is negligible since it brings a small amount of Okhotsk water into the Sea of Japan. Instead, the effect of climatological phenomena, notably the closeness of the Asian land mass, is considerable on the vertical and horizontal water temperature stratification. Its effect is most intense on the northern part of the Sea of Japan; whereas the effect of Sakhalin is much smaller on the eastern part of the sea. Author (TAB)

N68-15890*# GCA Technology Div., GCA Corp., Bedford, Mass.
ROCKET OBSERVATIONS OF ELECTRON TEMPERATURE IN THE E REGION
L. G. Smith, L. H. Weeks, and P. J. McKinnon Oct. 1967 21 p refs
(Contract NASw-1402)
(NASA-CR-92564; GCA-TR-67-13-N) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Electron temperature observations have been obtained with Langmuir probes carried on sounding rockets, principally the Nike Apache. A refinement of the instrumentation in which the rate of change of current is telemetered on a logarithmic scale has allowed the accuracy of individual measurements to be reduced to ±25°K compared with ±100°K obtained from direct analysis of the current-voltage characteristic. Rocket flights in Brazil during and following the solar eclipse of 12 November 1966 show that the electron temperature below 150 km remained constant; at greater heights a change of temperature was found, amounting to 300°K at 190 km. This supports the view that solar radiation does not directly determine the electron temperature of the E region. Electron temperatures are found always to be greater than the neutral gas temperature and, at a given altitude, the difference increases with increasing sunspot number. Author

N68-15968# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE ATMOSPHERIC PENETRATION OF ULTRAVIOLET RADIATION WITH WAVELENGTHS OF 100–2000 Å [O PRONIKNOVENII UL'TRAFIOLETOVOY RADIATSII S DLINAMI VOLN 100–2000 Å V ATMOSFERU]
Yu. P. Suslov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 167–171 refs (See N68-15951 06-06)

The atmospheric penetration of the solar ultraviolet radiation in the 100–2000Å wavelength region was calculated. Density data were obtained from 1958–1959 rockets and satellites. The results relate to the condition in the upper atmosphere in a period of maximum solar activity. In the 800–2000Å region it was assumed that the absorption originated only from O_2 and depended essentially on the vertical distribution of O_2 in the thermosphere. The results are depicted graphically with dots representing the depth of ultraviolet radiation penetration (H_λ) in the minima of the O_2 absorption bands and with x's, representing the maxima of the O_2 absorption bands. Calculations were also made of the depth with radiation at 45 and 60 degrees from the vertical. Author

N68-16001# Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
MORPHOLOGY AND SEDIMENTS OF THE TIMOR SEA
Tjeard H. van Andel (Scripps Inst. of Oceanog., La Jolla, Calif.) and J. J. Veevers 1967 242 p refs *Its* Bull. No. 83

Interpretation of the Timor Sea region morphology are used to define and characterize the sedimentary formation and its distribution patterns, and to discuss the topographic, oceanographic, geological, and biological factors of the area. Depositional layers of the Timor Sea are similar to those of other calcareous shelves but precipitated carbonates are absent; this is attributed to the great distance between the open ocean and the shallow turbulent zone where precipitation normally occurs. Overall surface sedimentary analyses establishes a strong resemblance in origin and distribution patterns to those of modern terrigenous shelves. G.G.

N68-16010# Institut Franco-Allemand de Recherches, St. Louis (France).
GROUND TESTS BY LANGMUIR PROBES TO MEASURE THE IONOSPHERE [ESSAIS AU SOL DE SONDES DE LANGMUIR DESTINEES AUX MESURES DANS L'IONOSPHERE]
J. Kaprelian and J. Auzilleau 28 Dec. 1966 28 p refs In FRENCH
(ISL-T-41/66)

Flight simulation methods are discussed, and results obtained by ground tests in the laboratory with Langmuir soundings of the ionosphere are reported. These results are intended to study the E region of the ionosphere. Types of soundings employed in the study and associated electronics are described, and experimental soundings with and without guard rings are reported.
Transl. by M.W.R.

N68-16062*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE SOILS OF POLAR WASTES AND THE ROLE OF B. N. GORODKOV IN THEIR STUDY
I. S. Mikhaylov Oct. 1967 8 p refs Transl. into ENGLISH from Izv. Vsesoyuznogo Geogr. Obschchestva (USSR), v. 94, no. 6, 1961 p 520–523
(Contract NAS7-100)
(NASA-CR-92526) CFSTI: HC $3.00/MF $0.65 CSCL 08G

An overview is presented on data pertaining to Arctic soils, with particular emphasis placed on the Gorodkov studies of the tundra and Arctic wastes zones, his division of them into subzones and provinces, and his classification of the soils as podzolic and boggy types. The main features of polar desert soils are discussed, and the aqueous and thermal behavior determined by climatic factors are characterized. The relationship between the chemical and biochemical reactions, which determines soil development, is considered, and it is established that the polar desert soils are a unique type possessing uniform transformation and substance movement. A reference bibliography is included. M.G.J.

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; tranducers; aerial photography; and telescopes and cameras.

N68-15007# Perkin-Elmer Corp., Norwalk, Conn.
THEODOLITE WITH SHAFT ANGLE ENCODER AND DISPLAY Final Report
J. G. Schaberg 6 Jun. 1967 47 p refs
(Contract DA-44-009-AMC-1489(X))
(Rept.-8736; AD-662080)

The Perkin-Elmer Corporation reports on the design, development, fabrication and test of DKM3 theodolite with shaft angle encoder and decimal angular display. The angular information is presented in instantaneously updated numbers to a resolution of 0.36 second of arc. The absolute accuracy is better than plus or minus 2 seconds of arc. Recommendations to improve the design are presented. Author (TAB)

N68-15071# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
A RECORDER FOR THE COSMIC RAY STATION "SKL"
Yu. A. Egorov *In its* Cosmic Rays, No. 8 1967 p 203–205
(See N68-15050 06-29)

The circuit of a simple automatic multichannal recorder for a cosmic ray observatory is considered. The output signal is an electric pulse train. The recording is made in the form of decimal printing on a punched tape in the teleprinter code. The digit capacity of each channel is three decades. The number of channels is necessarily from one to several tens. The simplicity of the design is achieved by maximum use of subassemblies of standard manufacture. Author

N68-15154# United Kingdom Atomic Energy Authority, Harwell (England). Electronics and Applied Physics Div.
SOME WAYS OF RECORDING OPTICAL SPECTRA USING IMAGE INTENSIFIERS
P. Iredale and D. J. Ryden Oct. 1967 24 p refs
(AERE-R-5112) HMSO: 3s 6d

The report considers several ways of using image intensifiers to record optical spectra. The properties of image intensifier-film combinations are considered. It is shown that the highest efficiency of utilization of the incoming signal information is obtained by counting individual photoelectrons via the flashes of light they produce at the intensifier output. Author

N68-15156# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
QUESTIONS ON THE DEVELOPMENT OF UNIVERSAL BALANCING EQUIPMENT [VOPROSY RAZRABOTKI UNIVERSAL'NOGO BALANSIROVOCHNOGO OBORUDOVANIYA]
L. N. Ozerov 25 Apr. 1967 24 p Transl. into ENGLISH from Teoriya i Konstrukt. Balansirovochnykh Mashin (Moscow), 1963 p 328–342
(FTD-MT-24-98-67; AD-662576)

Balancing machines MDB-1A, MDU-2, MDU-3 and MDU-210 for aeronautical rotors and balancing machines MDBG-1 and UUG-3 for gyroscope rotors are described. MDB-1A: two movable supports for balancing rotors of 15-100 kg. Electronic frequency pickup (to 10-15cps) consists of a line filter in a special circuit. MDU-2: built in 1952, was the first machine using stationary supports to pick up unbalanced forces (with piezoelectric pickups). Rotors 5-100 kg. A light beam reflected from the rotor onto a photocell and an electronic measuring system serve as the unbalance pickup. MDU-3: same MDU-2 for rotors of 5-500 kg but difficulties encountered with rotors above 100 kg led to development of MDU-210 which has stationary support, rotors 10-1000 kg. Electronic measuring devices permit balancing of above rotors within 1-10 gm-cm. Maximum rotor diameter 1400 mm, speed 800 and 450 RPM. MDBG-1: for gyroscope rotor balancing. Has mechanical frequency isolation with optical pickup and secondary vibration system for better sensitivity. No indication of exact place of unbalance. UUG-3: built in 1952 for gyroscope rotor balancing. Has mechano-optical system of picking up amount and place of unbalance. Uses mirrors on secondary vibration systems that rotate mirrors which project light beam reflected from rotor on a screen. Diameter of light circle indicates size, location of blank rotor marking indicates place of unbalance. Author (TAB)

N68-15179# Cornell Aeronautical Lab., Inc., Buffalo, N. Y.
MINIATURE PROBES FOR THE INSTANTANEOUS MEASUREMENT OF ENTHALPY IN ARC JETS Final Report, Jul. 1966–Jul. 1967
Franklin A. Vassallo Wright-Patterson AFB, Ohio ARL Sep. 1967 48 p refs
(Contract AF 33(615)-5204)
(CAL-IM-2286-W-1; ARL-67-0181; AD-662644)

A study is reported in which a very fast acting miniature total enthalpy probe is evaluated. The probe operates on the principle of total calorimetry but in contrast to other probe types using this principle, can operate in a very few milliseconds. Hence, enthalpy traverses in high temperature streams can be made in a single sweep of the probe. Experimental studies showed good probe performance at high temperature in both cooled and uncooled probe models. Probe diameters as small as 0.050 inches were constructed and used with success in a nitrogen arc jet at enthalpies up to 7000 Btu/lb. Comparative evaluations using other enthalpy measuring devices indicate the rapid response technique to be superior in terms of speed, size, simplicity, and operational limits. Probe accuracy appears to be comparable to that of the slower acting comparison methods used in the experimental work. Author (TAB)

N68-15209# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ADVANCED INSTRUMENTAL TECHNIQUES FOR ELECTRON MICROSCOPY
Richard F. Schneidmiller Sep. 1967 17 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-1; SAMO-TR-67-69; AD-663232)

Two recent modifications have improved the photomicrographic quality and increased the versatility of the HU-11 electron microscope, one modification consists of an exposure meter adapted to the electron microscope, and the other modification consists of a method of rapidly and economically replacing wire filaments. These two basic ideas can be applied to other microscopes. TAB

N68-15225# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.
A NEW NEUTRON DOUBLE DIFFRACTOMETER [EIN NEUES NEUTRONEN-DOPPELDIFFRAKTOMETER]
E. A. Jumpertz, W. Scharenberg, H. Stechemesser, and U. Altheus Aug. 1967 57 p refs In GERMAN Supported in part by the Bundesmin. fuer Wiss. Forsch. Prepared in cooperation with Bonn Univ., West Germ.
(JUL-500-RX)

Development and construction details for a neutron double diffractometer are given. The apparatus consists of two movable monochromators arranged one above the other, a relay steering mechanism directly coupled to the monochrometers, and high precision electronics. The nickel monochromators (//(100) for the power diffractometer, and //(110) for the single crystal diffractometer) obtain a λ_{max} of 1.38 Å for the latter, and varied wavelengths of 0.85 Å and 1.97 Å for the powder diffractometer at 28° to 86° deflection angles. Transl. by G.G.

N68-15233# Dorne and Margolin, Inc., Bohemia, N. Y.
CRAB ANGLE SENSING SYSTEM Final Report
George Birutis Nov. 1967 74 p
(Contract FA-66WA-1588)
(RD-67-61)

The feasibility of the design concept was successfully demonstrated during ground tests. The calculated probable error in the measurement of bearing angle was less than 0.3°. Aircraft accuracy tests were conducted with the CASS equipment installed on an FAA DC-6B (N-114). The results of these tests indicated a dead zone of approximately ±6°. The primary cause of the dead

zone could be attributed to the antenna installation since the measured performance of the electronics equipment was satisfactory. Based on the data obtained during this program, it is concluded that CASS is a feasible system for the determination of aircraft crab during landings. It is recommended that a further study be made of antenna types, their installation and location to determine the optimum antenna configuration for crab angle measurements.
Author

N68-15247# Deutsche Forschungsanstalt fur Luft- und Ramfahrt, Brunswick (West Germany). Institut fuer Flughuehrung.
AIRBORNE AND GROUND INSTALLATIONS FOR CONTINUOUS TRANSMISSION FROM METEOROLOGICAL SATELLITES [BORD- UND BODENANLAGEN ZUR STAENDEN NACHRICHRICHTENUEBERTRAGUNG VON METEOROLOGISCHEN SATELLITEN]
Christian Johansen 15 Aug. 1967 52 p refs In GERMAN; ENGLISH summary
(DLR-MITT-67-14)

After a short treatise on orbits and attitude stabilization of meteorological satellites this paper deals with their equipment for continuous picture transmission from the dayside of earth (APT-System). An infrared radiometer is described transmitting "temperature pictures" from the nightside of earth via APT-equipment. Transmission of ephemerides is performed by APT-pictures. Ground station equipment is discussed, especially picture recorders. Report is given about some investigations and works at such a machine.
Author

N68-15270# Institut Franco-Allemand de Recherches, St. Louis (France).
PROPOSAL ON NORMALIZATION FOR TECHNIQUES OF PRESSURE MEASUREMENT FOR AIRCRAFT SHOCK-WAVES [STANDARDISIERUNGSVORSCHLAG ZUR DRUCK-MESSTECHNIK FUER FLUGZEUGKNALLE]
M. Froboese 16 Jun. 1967 41 p refs In GERMAN; FRENCH summary
(ISL-T-23-67)

Ground arrangements and instruments are described which have been used in numerous experiments to measure sonic booms. A standardization of measuring methods and instrumentation is suggested to permit international exchange of the results of such tests. Covered in the paper are pressure transducers and converters, calibration methods, electrical registration equipment, and evaluation techniques.
Transl. by K.W.

N68-15272# Institut Franco-Allemand de Recherches, St. Louis (France).
PIEZOELECTRIC PRESSURE TRANSDUCERS—DYNAMIC CALIBRATION [CAPTEURS DE PRESSION A EFFET PIEZO-ELECTRIQUE, ETALONNAGE DYNAMIQUE]
F. Valentin 9 Feb. 1967 35 p refs In FRENCH
(ISL-T-7/67)

Described is an electronic device that registers the frequency variations of a piezoelectric pressure transducer. Investigated is its vibrational sensitivity and calibration.
Author

N68-15318# National Physical Lab., Teddington (England). Aerodynamics Div.
ERRORS IN THE MEASUREMENT OF LOW PRESSURES CAUSED BY TEMPERATURE GRADIENTS ALONG THE CONNECTING TUBE OF THE MEASURING INSTRUMENT
M. J. Lercombe 27 Jul. 1967 15 p refs
(NPL-AERO-1241; ARC-29309) CFSTI: HC $3.00/MF $0.65

The magnitude of the errors introduced when measuring low pressures on a wind tunnel model which is placed in a flow with a high stagnation temperature is discussed. The errors, which are due to thermal transpiration, are presented in graphical form for various temperature ratios between the model surface and the measuring instrument and for various radii of the connecting tube.
Author

N68-15333# Naval Academy, Annapolis, Md. Engineering Dept.
CALIBRATION OF HOT-FILM SENSORS IN A TOWING TANK AND APPLICATION TO QUANTITATIVE TURBULENCE MEASUREMENTS
G. F. Dreyer Mar. 1967 55 p refs Presented at Soc. of Naval Architects Meeting, Chesapeake Sect., Annapolis, 8 Mar. 1967
(AD-663098)

A calibration of two types of quartz-coated hot-film sensing elements in a towing tank is described. The calibration is done using hot-film anemometry and linearization of voltage signals. The hot-film sensors proved to be well-suited for flow measurements in water. They are rugged, sensitive, and reliable; and are preferred over the common hot-wire probe or pitot tube. Operation of the hot-film anemometer and linearizer for probe calibration is described. Techniques of hot-film anemometry are shown to be applicable to quantitative turbulence measurements in water. Use of a data acquisition system for this purpose is described.
Author (TAB)

N68-15364*# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.
LOW-ENERGY PROTON DAMAGE EFFECTS IN SILICON SURFACE-BARRIER DETECTORS
J. A. Coleman (Natl. Bur. of Std., Washington, D. C.), D. P. Love, J. H. Trainor, and D. J. Williams Dec. 1967 26 p refs
(NASA-TM-X-63082; X-611-67-638) CFSTI: HC $3.00/MF $0.65 CSCL 14B

In order to predict the useful lifetime of semiconductor detectors which operate in the Earth's trapped radiation belts, the effects of damage by 50 keV, 200 keV, 600 keV and 1 MeV protons on silicon, surface-barrier, transmission detectors have been studied for fluences from 10^{10} to 10^{14} protons/cm^2. Detector current, noise and capacitance increased with fluence, with significant increases occurring after 10^{13} protons/cm^2. Bias-voltage-dependent multiple peaking was observed with Am-241 alpha particles. The effects of damage by protons with these low energies are significantly reduced in transmission detectors if the protons enter the rear, aluminum contact rather than the front, gold contact.
Author

N68-15371# European Southern Observatory, Hamburg (West Germany).
ESO BULLETIN NUMBER 2
Aug. 1967 59 p refs In FRENCH and ENGLISH
CFSTI: HC $3.00/MF $0.65

Optical system and other details are given for the 3.5 m telescope for the European Southern Observatory in Chile, and the parabolic mirror used is illustrated. An examination is made of a 372 cm fused silicon disk, and an antiflexure bearing for large astronomical mirrors is considered. Another article discusses mirrors and mountings for astronomical telescopes, and construction activity of the European Southern Observatory is also described.
Transl. by M.W.R.

N68-15478# California Univ., Livermore. Lawrence Radiation Lab.
IMPROVEMENTS IN THE SOLID-STATE PLUTONIUM-ALPHA AIR MONITOR

C. L. Lindeken and R. W. Lakin 19 Apr. 1967 12 p refs
(Contract W-7405-ENG-48)
(UCRL-50228) CFSTI: HC $3.00/MF $0.65

A fully transistorized plutonium-alpha air monitor based upon the use of a surface-barrier detector and a single-channel pulse-height analyzer is described. The monitor is designed for use in buildings having a central sampling system; it depends on this system or on an external air pump for its air flow. When the monitor is operated at 2 cfm, the detection sensitivity for the ^{239}Pu is 4 mpc-hours. This instrument is less expensive, more sensitive, and more compact than a previous model. Author (NSA)

N68-15503*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.
HIGH ALTITUDE RADIATION MEASUREMENTS Quarterly Progress Report, 1 Jul–30 Sep. 1967
Fred L. Bartman Jan. 1968 22 p refs
(Contract NASr-54(03); ORA Proj. 05863)
(NASA-CR-92529; QPR-19; Rept.-05863-19-P) CFSTI: HC $3.00/MF $0.65 CSCL 20F

Laboratory testing of the interferometer, preparations for the next balloon flight, and work on laboratory measurements of CO_2 transmission are described. Author

N68-15544 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ACADEMY OF SCIENCES OF THE USSR. NEWS. MECHANICS AND MACHINE BUILDING
7 Jun. 1967 50 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Mekhan. i Mashinostr. (Moscow), no. 3, 1964 p 71–78, 79–86, 152–154
(FTD-MT-64-536; AD-662479)

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3. ON MOTION OF THE FREE GYROSCOPE WITH CALCULATION OF INTERNAL FRICTION IN ELASTIC ELEMENTS OF ITS CONSTRUCTION L. I. Kargu, I. M. Okon, and L. I. Roberman p 33–39 refs (See N68-15547 06-14)

N68-15545 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CONDITIONS OF IMPERTURBABILITY OF THE SINGLE-ROTOR GYROCOMPASS [USLOVIYA NEVOZMUSHCHAYEMOSTI ODNOROTORNOGO GIROKOMPASA]
G. D. Bloyumin and M. V. Chichinadze *In its* Acad. of Sci. of the USSR. News. Mech. and Machine Building 7 Jun. 1967 p 1–16 refs (See N68-15544 06-14)

Considered is a gyrocompass stable against perturbations if the indicated direction is fully specified by the velocity with which its base moves across the earth's sphere and is independent of the acceleration of such a motion. Such a stability was studied in the case of two types of single-rotor gyrocompasses. The first class refers to compasses whose gyroscope has three degrees of freedom and the center of gravity is displaced upward or downward relative to the point of support (pendulum gyrocompass). Such are the floating gyrospheres of the known "Kurs"-type compasses, or the gyro-horizon compass, if the axes of the gyroscopic chambers are fixed at an angle ϵ specifying the position of the gyroscopes relative to the gyrosphere. The second category of compasses under study are those whose sensitive element represents an astatic gyroscope, and the compass effect is achieved through applied moments produced by moment-sensing elements controlled by the horizon indicators. Author

N68-15546 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SYSTEMATIC DEPARTURES OF THE TRIAXIAL GYROSCOPIC PLATFORM, CAUSED ITS ANGULAR OSCILLATIONS [O SISTEMATICHESKIKH UKHODAKH TREKHOSNOY GIROSKOPICHESKOY PLATFORMY, VYZVANNYKH EE UGLOVYMI KOLEBANIYAMI]
V. A. Zinenko *In its* Acad. of Sci. of the USSR. News. Mech. and Machine Building 7 Jun. 1967 p 17–32 refs (See N68-15437 06-08)

The report considers the causes of systematic drift of a stabilized axial gyro platform relative to fixed directions in inertial space. The successive approximation method is used to analyze conditions producing drifts. A system of three equations is formulated to express the motion of each gyro housing relative to their respective axes of precession. Analysis of these equations indicates that harmonic angular oscillations relative to any one axis can result in drifting along two stabilization axes; drifts are proportional to the squares of the oscillation amplitudes and frequencies. Angular oscillations of a platform relative to any two axes produce simultaneous drifting in relation to its axes. Synchronous oscillations along two axes produce drifting relative to the third axis, which is proportional to the amplitudes and frequencies of oscillation and independent of any platform parameters. In-phase oscillations relative to a stabilization axis and an axis coincident to the direction of gyro rotation at the initial moment produces drifting proportional to the kinetic moment and amplitudes of oscillation. Author

N68-15547 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON MOTION OF THE FREE GYROSCOPE WITH CALCULATION OF INTERNAL FRICTION IN ELASTIC ELEMENTS OF ITS CONSTRUCTION [O DVIZHENII SVOBODNOGO GIROSKIPA S UCHETOM VNUTRENNEGO TRENIYA V UPRUGIKH ELEMENTAKH YEGO KONSTRUKTSII]
L. I. Kargu, I. M. Okon, and L. I. Roberman *In its* Acad. of Sci. of the USSR. News. Mech. and Machine Building 7 Jun. 1967 p 33–39 refs (See N68-15544 06-14)

This article studies nonlinear equations in the presence of the stiffness and internal friction within elastic elements. The numerical calculation of the systematic drift speed of a free gyroscope in the presence of elasticity of its constructive elements under the action of a perturbation in the form of a nonzero initial velocity around an external axis is compared with results obtained by other authors using different formulas. Author

N68-15567# Human Factors Research, Inc., Santa Barbara, Calif.
A PRELIMINARY EVALUATION OF THE ELASTIC SURFACE TRANSFORMATION FOR PROCESSING AND DISPLAYING PASSIVE SONAR AND PHOTOGRAPHIC INFORMATION
Robert J. Hall, William F. Dossett, and Gene R. Kelley 16 Nov. 1967 33 p refs
(Contract N00014-67-C-0312)
(TM-778-1; AD-662257)

The goal of the research was to enhance images (signals) of low contrast and resolution by means of the elastic surface transformation (EST). The EST is a new display processing technique

that permits the observer to manipulate and enhance marginal signals. The EST process consists of photographically transferring information from some sensor to a uniformly prestretched surface. The surface is then relaxed in a continuous fashion, producing a uniform spatial compression. During compression the element size remains constant. The shrinking changes the spatial dispersion, which increases the density of the elements per unit area. This increases the image contrast and enhances the dim edges and gradients. Optical magnification maintains the enhanced image at its original size. The major achievements of the present research were: (1) the development of a technique for implementing the EST, and (2) demonstrating enhanced marginal photographic images. These results show that it is possible to enhance images that could not be seen prior to the transformation. Author (TAB)

N68-15658# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

FOUNDATIONS OF ANALYTIC METHODS OF STEREOPHOTOGRAMMETRIC PREPARATION OF MATERIALS OF AERIAL PHOTOGRAPHY

N. D. Il'inskiy 7 Sep. 1967 189 p refs Transl. into ENGLISH of the book "Obosnovaniye Analiticheskikh Metodov Stereofotogrammetricheskoy Obrabotki Materialov Aerofotos" Yemki Moscow, Izd. Geod. Lit., 1959 p 1–179
(FTD-MT-65-517; AD-662247)

The book treats of various aspects of aerial photogrammetry in three main parts. Part I introduces the exact analytical relationships between the coordinates of perspectively conjugate points of oblique and vertical aerial photographs, employing various auxiliary coordinate systems located in the plane of inclination of the photograph. The accuracy of working formulae is also investigated, and approximation formulae which satisfy preestablished requirements for accuracy and those used to determine or orientation elements and the elevations of ground points, depending upon the absolute values of the angles of inclination of aerial photos, terrain relief, etc. are given. Part II discusses the determination of relative orientation elements and the substantiation of their different systems. Part III gives formulae which combine corrections for x-parallax measurements with relative orientation elements, depending upon the accepted system of relative (or exterior) orientation and the chosen initial direction in which a pair of overlapping aerial photographs were oriented in the apparatus. Electronic computers are being used to some degree in the Soviet Union for photogrammetric computations. TAB

N68-15659 Deutsche Forschungsanstalt fur Luft- und Raumfahrt, Brunswick (West Germany).

INVESTIGATIONS ABOUT THE SYSTEMATIC AND RANDOM ERRORS AT TAKE OFF AND LANDING MEASUREMENTS WITH A SINGLE KINETHEODOLITE [UNTERSUCHUNGEN UEBER DIE SYSTEMATISCHEN UND ZUFAELLIGEN FEHLER BEI START UND LANDEMESSUNGEN MIT EINEM EINZELNEN KINOTHEODOLIT]

O. Weber Jul. 1967 80 p refs In GERMAN; ENGLISH summary

First, a survey of the fundamentals for measuring the take-off and landing of an aircraft with a kinetheodolite, is given. Flight path errors arise from the observed object deviating from the desired flight path, from faulty positioning and adjustment of the kinetheodolite, from dynamic deformation of the kinetheodolite during measurements and from inaccouracies in the evaluation of the kinetheodolite films. For each of the different errors, a simple model was developed and information on the on the magnitudes of the errors is given herein. This information is based on measurements of a HFB 320 jet aircraft and on kinotheodolite investigations made in the laboratory. In conclusion, suggestions are made for the reduction of the more important error sources. With careful planning and by observing certain rules during the observations and the data processing procedure, take-off and landing measurements of jet turbine aircraft made with a single kinetheodolite can be accomplished with such a degree of accuracy that the larger part of the total error of the flight test is due to the inability to exactly reproduce the take-off and landing and to the difficulty in detecting exactly the environmental conditions during measurements. Author

N68-15658# New Zealand. Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.

A TRANSISTORIZED ELECTROSTATIC FIELD METER

J. H. Buckingham May 1967 18 p refs
(TN-198) CFSTI: HC $3.00/MF $0.65

Static electricity has always been troublesome in industries handling or processing materials which, in themselves, are good electrical insulators. In areas where dangerous concentrations of flammable dust may arise, any static build up may well constitute a potential source of ignition for the mixture. The instrument described herein was developed to measure electric field strengths up to levels at which arcing occurs. It exhibits a linear response to variations in field intensity from 50 v/cm to 6000 v/cm for separation distances up to 15 cm. Author (ESRO)

N68-15660# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

POSITION SENSING SEMICONDUCTOR DETECTORS

R. B. Owen and M. L. Awcock Oct. 1967 32 p refs
(AERE-R-5393)

A new design of detector is described in which the resistive film constitutes the front electrode. Two-dimensional detectors were made using a rectangular square of high resistivity n-type silicon diffused with phosphorus. Palladium is used for the surface barrier p-n junctions, and three virtual earth amplifiers can be connected to the resistive electrodes. Design considerations are discussed, and the detector construction and performance are described. N.E.N.

N68-15661*# Northrop Space Labs., Hawthorne, Calif.

FLIGHT MODEL CESIUM ION SOURCE FOR ELECTRIC FIELD MEASURING INSTRUMENT

S. H. Levine and S. R. Harrison [1968] 19 p
(Contract NAS2-4143)
(NASA-CR-73177; NCL-68-2) CFSTI: HC $3.00/MF $0.65 CSCL 14B

The design and construction of the ion beam source are described. In the source assembly, the cesium vapor passes through the reservoir and feed tube to the ionizer, from which the accelerator extracts the ion beam and accelerates it toward the other assemblies. A spacer assembly locates the lens at the appropriate distance, and the lens module consists of a three-plate equipotential lens. Two plate electrodes and seven guard rings produce the uniform electric field for deflecting the ion beam. N.E.N.

N68-15726# Naval Radiological Defense Lab., San Francisco, Calif.

A VERSATILE, LARGE-MEMORY PULSE-HEIGHT ANALYZER FOR GAMMA RAY SPECTROMETRY

Bruce A. Euler 8 Jan. 1968 20 p
(USNRDL-TR-67-135; AD-663268)

A 16,384-channel pulse-height analyzer was designed and built to achieve maximum benefit from any of several special

detection systems. Although the analyzer was intended primarily for coincidence gamma-ray spectrometry, broader usage potentialities were recognized so that, in the design, features were included which make this instrument useful for a variety of measurements in radiochemical and nuclear physics research. Some important features are: It can be used for the collection of either single- or two-parameter spectra, and provides for a wide selection of channel resolution in both applications; in collection of singles spectra, a series of spectra can be collected in rapid sequence, and each spectrum held in the memory until the entire series has been collected; a 16-position programmer makes it possible to specify a measurement sequence and to have it proceed automatically; an identifying block of words can be composed and optionally inserted directly into the analyzer memory; all or selected portions of the data can be inspected directly and easily; internal registers can be used for the selection of specific channels for display or for the summation of counts; punched-card and magnetic tape output options are available. Author (TAB)

N68-15754# Atomic Energy Establishment, Winfrith (England).
A DIFFERENTIAL CONCENTRATION GAS CHROMATOGRAPH FOR THE ANALYSIS OF LOW LEVELS OF IMPURITIES IN HELIUM
P. S. Gray, D. R. Owens, and L. O. Green Jul. 1966 21 p
(DP-443) CFSTI: HC $3.00/MF $0.65

The development of a differential concentration gas chromatograph is described from a basic principle to an on-line plant instrument capable of analyzing helium from O_2, N_2, CO, CO_2, and CH_4 to better than 0.1 vpm with a high degree of reliability. Full details of construction are given together with an account of the performance of the instrument. Author (NSA)

N68-15807*# Kinelogic Corp., Pasadena, Calif.
DESIGN, DEVELOPMENT, FABRICATION, AND TEST, IMPROVED MAGNETIC TAPE RECORDER Final Engineering Report
Rubin Shatavsky 31 Oct. 1966 80 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951128)
(NASA-CR-92550; Rept.-079100) CFSTI: HC $3.00/MF $0.65 CSCL 14C

An experimental test model (ETM) of a spaceborne magnetic tape recorder is described. The recorder features an iso-elastic tape drive system using a seamless polyester belt riding directly on the outer layer of the tape in each reel. Two configurations were considered: 6×6 and 6×7-3/4 inches. The 6×7-3/4 inch configuration was built and tested as the ETM model. The recorder has an estimated reliability of 4400 hours at a 50% confidence level with tape speed of 4 ips. Tape speeds of 1, 2, 4, and 8 ips are possible. Included are a paper on the iso-elastic drive concept; an analysis of tape deck loading; and reports on electron beam welding methods for the ETM housing, bearing torque traces, and bearing characteristics. E.C.

N68-15873# General Electric Co., Schenactady, N. Y. Heavy Military Electronics Dept.
DEFORMABLE FILM RECORDING STUDY Final Report, Jun. 1966–Apr. 1967
J. E. Bigelow Griffiss AFB, N. Y. RADC Nov. 1967 92 p refs
(Contract AF 30(602)-4256)
(S-67-1139; RADC-TR-67-406; AD-662889)

The report covers the development, design and performance of a photoplastic recording (PPR) film recording and projection apparatus. The apparatus has demonstrated that characters formed by a cathode ray tube image on Type 216 PPR film behind a lenticular screen can be recorded at one millisecond per character such that the pattern of the lenticular screen controls light diffraction in the projection step to permit a four-color display. Cathode ray tube (CRT) phosphor life of over 500,000 frames is inferred from test data. Author (TAB)

N68-15893*# National Aeronautics and Space Administration, Lewis Research Center, Langley Station, Va.
TEMPERATURE AND LIQUID-LEVEL SENSOR FOR LIQUID-HYDROGEN PRESSURIZATION AND EXPULSION STUDIES
Robert J. Stochl and Richard L. De Witt Washington Feb. 1968 23 p refs
(NASA-TN-D-4339) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A temperature-measurement technique that uses thermopiles (i.e., thermocouples in series) as sensors was developed. The results of this development indicate (1) that an instrument rake using measurement stations constructed of thermopiles can measure temperatures to within ±1.65°K (for gas temperatures between 20° and 300°K) and (2) that, in addition to their use as temperature sensors, thermopile units can be used as point liquid-level sensors for subcooled liquid during liquid outflow. Tests indicate that thermopiles can detect liquid level to within ±0.453 centimeter. Author

N68-15936*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
BIMETAL SENSOR FOR AVERAGING TEMPERATURE MEASUREMENT OF NONUNIFORM TEMPERATURE PROFILES
Ralph T. Dittrich and Michael P. Lynch Washington Nov. 1967 19 p refs
(NASA-TN-D-4242) CFSTI: HC $3.00/MF $0.65 CSCL 14B

A single-probe instrument was developed for measuring an average temperature over a nonuniform temperature profile. This probe uses the principle of differential thermal expansion of two different materials. The performance of such a probe was demonstrated experimentally by using a prototype probe for a single temperature indication over temperature profiles which varied as much as 750°C. Probe temperature measurements obtained during several runs averaged as much as 13°C lower than temperatures obtained from averaging the measurements of eight thermocouples equally spaced along the probe length; analysis shows that for steep temperature gradients the probe-measured temperature is a better average than the average temperature obtained from the eight thermocouples. The instrument can be adapted to wide temperature ranges by the proper selection of probe geometry and materials. Author

N68-15999# Ateliers de Constructions Electriques de Charleroi (Belgium).
TESTS ON ACEC VIDEOMETER IN FOG CHAMBER AT UNIVERSITY OF CALIFORNIA, BERKELEY, CALIFORNIA, U.S.A. Final Report
R. A. Brousmiche, I. L. Dujardin, M. E. Etienne, P. Rouet, R. L. Scohy, et al Jul. 1967 22 p Sponsored by FAA Prepared in cooperation with the Belg. Airports and Airways Agency
(FAA-RD-67-32)

This report deals with a videometer for measuring visibility along airport runways. Fog chamber tests were conducted with a manual and an automatic version of the equipment to verify values obtained during operations at the Brussels National Airport, Belgium. The equipment consists of the videometer and a television

screen display device. The present report describes test conditions and gives the results obtained with the manual and the automatic videometers. Measurements made simultaneously with both versions of the equipment and by human observers are compared. K.W.

N68-16070# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
CONTROL OF THE AUTODYNE FREQUENCY IN A SELF-LOCKING NMR MAGNETOMETER [UPRAVLENIE CHASTOTI AVTODINA V SLEDYASHCHEM ZA POLEM YAMR MAGNITOMETRE]
V. M. Lachinov 1967 11 p refs In RUSSIAN
(JINR-P9-3527)

A scheme of an autodyne detector used in a completely automatized NMR magnetometer is presented. An arrangement is designed using varicaps to control the autodyne frequency that provided the conditions close to optimal for the servomechanism. Author (NSA)

N68-16078# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
METHOD OF INVESTIGATING STAR IMAGE VIBRATIONS AS AT THE INPUT OF PHOTOELECTRIC TRACKING SYSTEM [METOD ISSLEDOVANIYA DROZHANIYA IZOBRAZHENIYA ZVEZD, KAK POMEKHI NA BKHODE FOTOELEKTRICHESKOY SLEDYASHCHEY SISTEMY]
I. P. Rozhnova 23 Aug. 1967 10 p refs Transl. into ENGLISH from the Publ. "Avtomatizirovannyy Elektroprivod. Sledyashchiye Sistemy. Upravleniye i Preobrazovatel'nyye Ustroystva" 1965 p 87-90
(FTD-HT-66-596; AD-663339)

During the determination of sensitivity of photoelectric slave systems for automatic telescope guidance, the fluctuations of the dark current are assumed to represent the basic input perturbation. However, during the tracking of stars additional input interferences may be generated by the flickering of stars. The basic method for the study of such flickering consists of the study of the so called traces. The present article describes a more objective photoelectric balance method for the study of flickering developed at the Institut elektromekhaniki (Institute of Electromechanics). The method was described elsewhere. The present note describes certain modifications introduced in 1963 and gives, as an example, a spectral density diagram obtained by means of the AZT-7 telescope of the KrAO. TAB

N68-16086# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
FAST COINCIDENCE β SPECTROMETER WITH A TRIANGULAR-SHAPED MAGNETIC FIELD [SVETOSIL'NYI LINZOVYI β-SPEKTROMETR SOVPADENII S TREUGOL'NOI FORMOI MAGNITNOGO POLYA]
V. A. Morozov and T. M. Muminov 1967 21 p refs In RUSSIAN
(JINR-P13-3437)

A fast coincidence β spectrometer with triangular shaped magnetic field was constructed, based on the Gerholm spectrometer. The focusing properties of the triangular magnetic field were calculated. The electron-optical system and the recording system of the spectrometer are described. The modifications made to the basic Gerholm spectrometer led to an increased degree of the azimuthal symmetry of the magnetic field and improvement of its characteristics. NSA

N68-16100*# Kinelogic Corp., Pasadena, Calif.
DESIGN STUDY OF TRADEOFFS IN SPACECRAFT TAPE RECORDER DEVELOPMENT Final Engineering Report
Irving Karsh, Richard Couchman, Rubin Shatavsky, and Arnold Cronshagen 19 Jun. 1967 179 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951937)
(NASA-CR-92539; Doc.-6196723) CFSTI: HC $3.00/MF $0.65 CSCL 14C

The development of information concerning various aspects of tape recorder systems is discussed. An evaluation of the specifications for an iso-elastic tape recorder is made, and it is shown that the desirable characteristics are usually mutually exclusive. Two approaches were employed in the study. The first was to study the design, and the resultant functional characteristics of a spectrum of iso-elastic tape recorders. The second approach deals with theoretical analysis of the effect of head-to-tape contact on signal to noise ratio and error rate of the signal channel, and also the effect of time degradation of components on signal to noise ratio for both analog and digital systems. Included are discussions of tape recorder characteristics analyses, analysis of mean time before failure, the effect of varying tape thickness, serial and parallel methods of recording digital data, reliability of serial and parallel methods, analog and digital comparisons, and the selection and reliability of servocontrol and synchronous drive systems. C.T.C.

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N68-15009# Aberdeen Proving Ground, Md. Army Coating and Chemical Lab.
SINTERED IRON BRAKE CYLINDER PISTONS. FINAL RESULTS OF LABORATORY AND FIELD TESTS Final Report
Charles B. Jordan Nov. 1967 22 p refs
(CCL-238; AD-662077)

A four year study of sintered iron brake wheel cylinder pistons versus aluminum pistons was conducted. Laboratory, static, and operational field tests were run. Corrosion was eliminated and gumming was greatly reduced in all cylinders containing sintered iron pistons. In operation, wear was diminished and the volume of sediment which formed in the brake system was greatly reduced. Author (TAB)

N68-15010*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
REDUCED PRESSURE ENVIRONMENT EFFECTS ON ROLLING ELEMENT FATIGUE LIFE WITH SUPER REFINED MINERAL OIL LUBRICANT
David W. Reichard, Richard J. Parker, and Erwin V. Zaretsky Washington Jan. 1968 17 p refs
(NASA-TN-D-4348) CFSTI: HC $3.00/MF $0.65 CSCL 13I

A modified NASA five-ball fatigue tester was used to investigate the effect of a reduced-pressure environment on

rolling-element fatigue life, deformation, and wear of SAE 52100 steel balls with a super-refined naphthenic mineral oil used as the lubricant. Tests were conducted at atmospheric pressure, at a 20° contact angle, with a thrust load of 60 pounds (267 N) to produce an initial maximum Hertz stress of 800,000 psi (5.5×10^9 N/m^2) at a shaft speed of 4900 rpm with no heat added. The atmospheric-pressure tests served as reference data for tests conducted at a reduced pressure, approximately the vapor pressure of the lubricant. For these reduced-pressure tests, the ball specimens were lubricated by a quasi-mist method and by immersion in the lubricant. In both cases, all other test conditions were the same as those in the atmospheric-pressure tests. No significant difference in the fatigue lives was observed for tests conducted at atmospheric pressure and those conducted at reduced ambient pressure. The amounts of deformation and wear for the two pressure conditions differed little, regardless of the lubrication mode employed, which was an indication of a sufficient elastohydrodynamic lubricating film at the reduced-pressure levels. Author

N68-15035 Technische Hochschule Hannover (West Germany).
STUDIES OF ELECTROHYDRAULIC FORMING OF SHEET METAL UNDER WATER [UNTERSUCHUNGEN ZUR BELCHUMFORMUNG DURCH FUNKENENTLADUNG UNTER WASSER]
Heinz Ismar (Ph.D. Thesis) 1967 142 p refs In GERMAN

Electrohydraulic forming of sheet metal under water was analyzed for the electrical energy necessary to obtain the required shock wave impulses. Theoretical, and measured results on impulse exchanges between shock wave and metal specimen established a definite relationship between the effectiveness of the shock wave impulse, the volume of the sample specimen, and the optimization and transfer of freed kinetic energy. Transl. by G.G.

N68-15096# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLID LUBRICANTS WITH MOLYBDENUM DISULFIDE AND THE REDUCTION OF INSTRUMENT WEAR [TVERDYYE SMAZKI S DISUL'FIDOM MOLIBDENA I SNIZHENIYE IZNOSA INSTRUMENTOV]
Ye. M. Oparina, L. N. Sentyurikhina, V. A. Markov, and Z. S. Rubtsova 28 Jul. 1967 12 p Transl. into ENGLISH from Mashinostroitel' (USSR), no. 1, 1966 p 30–31
(FTD-HT-23-920-67; AD-662790)

Methods of forming solid films of molybdenum disulfide on friction surfaces are discussed. TAB

N68-15168# Bristol Siddeley Engines, Ltd. (England).
FLOW TURNING
London Min. of Tech. Dec. 1967 45 p
(S/T MEMO-4/67; AD-662566)

Flow turning, in which the work piece is plastically deformed over a hardened, rotating mandrel by the action of one or more hardened rollers, is especially useful in the manufacture of engine components from present-day expensive alloys since the volume of material worked remains the same throughout the process; there is no waste in the form of swarf, etc. Descriptions are given of the fundamentals of the process, the machines and tooling required, the advantages and disadvantages of the process, the materials which can be worked, and typical components. Author (TAB)

N68-15173# Naval Ship Research and Development Center, Annapolis, Md.
PROGRESS TOWARD LONG-LIFE BEARINGS
Thomas L. Daugherty and Mark S. Rosenfeld Nov. 1967 17 p
(Rept.-2477; AD-662193)

The need for longer lasting, more reliable ball bearings in Navy applications led to investigations of various means of improved lubrication. Included are studies of new methods of bearing lubrication as well as causes of and modes of lubricant loss. Experiments with oil-impregnated porous nylon ball bearing retainers for use in typical Navy machinery indicate their feasibility in achieving long bearing life. Experiments to determine the cause of a pressure gradient existing across a shielded bearing in an electric motor revealed the internal motor-cooling fan as one cause, and considerable air flow as a result of the pressure gradient. Author (TAB)

N68-15213# Technische Hochschule Hannover (West Germany).
PHYSICAL AND TECHNICAL BASES FOR THE EFFECT OF ELECTROMAGNETIC AUXILIARY FIELDS ON ARC WELDING PROCEDURES [PHYSIKALISCHE UND TECHNISCHE GRUNDLAGEN ZUR WIRKUNG ELEKTROMAGNETISCHER ZUSATZFELDER AUF ELEKTRO-SCHWEISSVERFAHREN]
Ekkehard Feustel (Ph.D. Thesis) 1966 127 p refs In GERMAN

The effects of exterior applied magnetic fields of known properties on the arc welding process were studied by observing the physical transfer characteristics between magnetic field, electric arc, and drop charge transformation. Theoretical and experimental results established the magnetic field's Lorentz force as the factor that influenced the electric arc current; it initiated a rotary arc motion that in turn cooled the exterior arc boundaries and led to energy concentration in the arc interior. This increased maximal temperature, arc rotation, and the magnetic force acting on the fusing electrode changed drop charge transfer mechanism to a finer consistency and thus the sintering velocity increased. Newly developed was an electronic switching device that regulates the magnetic field impulse and synchronizes drop charge transfer with the field frequency. Transl. by G.G.

N68-15237# Naval Air Development Center, Johnsville, Pa. Aero Materials Dept.
SECURING FASTENERS AND OTHER ASSEMBLING DEVICES; REVIEW AND EVALUATION OF PRESENT PRACTICES, DESIGN, USAGE LIMITATIONS, AND ENGINEERING DOCUMENTATION; ESTABLISHMENT OF
Alexander M. Phillips 26 Jul. 1967 17 p refs
(NADC-MA-6702; AD-662031)

The purpose of the work was to review and evaluate fastener-safety devices and methods and the applicable engineering documentation; and to investigate the relative reliability of such methods and devices. Author (TAB)

N68-15287# TELDIX Luftfahrt-Ausruestung G.m.b.H., Heidelberg (West Germany).
THEORETICAL AND EXPERIMENTAL RESEARCH ON THE LOAD CAPACITY OF AN EXTERNALLY PRESSURIZED STEP JOURNAL BEARING WITH A SINGLE ROW OF FEEDING HOLES [THEORETISCHE UND EXPERIMENTELLE UNTERSUCHUNGEN ZUR TRAGKRAFT DES EINREIHIGEN HYDROSTATISCHEN RADIALLAGERS MIT STAUKAMMER-RING]
W. Fehse Bad Godesburg, W. Ger. Bundesmin. Fuer Wiss. Forsch. Jun. 1967 54 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-09)

This report treats the load capacity of a newly developed hydrostatic journal bearing for use in gyros. The first part of the report comprises a theoretical exposition of flow and pressure conditions within the bearing and a derivation for the load capacity as a function of bearing geometry and the supply pressure for incompressible flow. In the experimental research of part 2 the approximations about the pressure distribution on the basis of measured pressures are discussed. These approximations are necessary to derive the load capacity equations and they are fairly verified. In the concluding part the load capacity equation is indirectly proved by the results of pressure measurements. Author

N68-15301# Picatinny Arsenal, Dover, N. J. Feltman Research Labs.
EFFECT OF RELATIVE HUMIDITY ON ADHESIVE BONDING TO ALUMINUM ALLOY
Modesto Barbarisi and J. Richard Hall Dec. 1967 19 p refs
(PA-TM-1785; AD-662747)

Observations indicate that at low relative humidity a contact angle of about 5 degrees can be obtained for water on prepared aluminum. The same surface exposed to 100% relative humidity exhibits poor water wettability. The situation is reversed for a polyamide-epoxy adhesive. Wetting was improved under conditions of high rather than low relative humidity. Consistent with this adhesives wetting behavior, adhesive joints prepared with it under high relative humidity conditions were stronger than those produced under dry conditions. Author (TAB)

N68-15334 Technische Hochschule Hannover (West Germany).
RESEARCH ON THE FILLING PROCESS DURING COMPRESSION TESTS ON PIPES [UNTERSUCHUNG DES FUELLVORGANGS BEI ROHRPRUEFPRESSEN]
Ansgar Schulte (Ph.D. Thesis) 1966 172 p refs In GERMAN

The layout of the automatic press and the process of filling the pipe to be pressure tested with water were analyzed in order to optimize test time and to improve operational safety. The aim was to achieve complete evacuation of air in the pipe within a minimum of time and under reproducible conditions. A mathematical method is presented for determining filling time as a function of excess water volume and to identify the major factors affecting filling time. Experiments were conducted to study the filling process and to analyze the excess water volume. Methods are discussed by means of which the excess water volume can be kept to a minimum. Transl. by K.W.

N68-15368*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
LONG TERM VACUUM STORAGE TEST AND VIBRATION EFFECTS EVALUATION ON MULTI-LAYER SUPER INSULATION BLANKETS. SUPPLEMENT TO VOYAGER THERMAL INSULATION SYSTEMS. PHASE 2: Summary Report
R. W. Carr and C. S. Lankton 1 Nov. 1967 24 p Prepared for JPL
(Contracts NAS7-100; JPL-951537)
(NASA-CR-92589; DIN-67SD4405-S) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Super insulation blankets were subjected to a sixty day exposure to vacuum levels in the 10^{-8} torr range while radiating to walls cooled by liquid nitrogen. At the end of the sixty day time period, the blankets were subjected to broad-band vibration levels of 3.77 G to 4.66 G RMS while at vacuum/cryogenic conditions. There was no apparent physical damage to the insulation and no measurable change in the thermal performance. Author

N68-15472# Technische Hochschule Hannover (West Germany).
CONTRIBUTION TO THE QUESTIONS OF MAIN AND ERROR GEOMETRY CONCERNING SUPERSONIC VIBRATING HEADS [BEITRAG ZUR FRAGE DER HAUPT- UND FEHLER-GEOMETRIE BEIM SCHWINGLAEPPEN MIT ULTRASCHALL]
Tycho Vetter (Ph.D. Thesis) 1967 197 p refs In GERMAN

Parametric design and dimensioning data were derived for tool holder shafts shaped as step-recessed cylinders, exponential tips, cones, and hyperbolic tips. Standard curve sheets are presented which contain data on transfer ratio, resonance length, flexibility, and diameter of the various tool holders for a diameter ratio range from 1 through 25. Under error geometry, the effects of tool wear on the quality of the work are analyzed. Reference data on tool wear are presented for glass, ceramics, hard metals, aluminum, and steel. A second analysis treats error effects of the machine, the vibratory system, and joints within the entire system. Transl. by K.W.

N68-15499# Federal Power Commission, Washington, D. C. Bureau of Power.
DEVELOPMENT OF ELECTRICALLY POWERED VEHICLES
Feb. 1967 53 p refs Prepared for Comm. on Commerce, U. S. Senate
(PB-174982) CFSTI: HC $3.00/MF $0.65

Contents: History of electric vehicles; Present status of battery-powered vehicles; Electric energy storage systems; Electric vehicles; Public acceptance of the short-range electric vehicle; Electric power requirements; The electric vehicle and air pollution; Electric vehicle legislation. Author

N68-15504*# Kinelogic Corp., Pasadena, Calif.
COMPARISON FATIGUE LIFE TEST OF SEAMLESS POLYESTER FILM BELTS FABRICATED BY AN ALTERNATE SOURCE Final Engineering Report, 1 Jul.–31 Oct. 1966
Ivy Karsh 10 Nov. 1966 17 p refs Prepared for JPL
(Contracts NAS7-100; JPL-377029)
(NASA-CR-92519; TWX-919-588-3287; Doc.-118001) CFSTI: HC $3.00/MF $0.65 CSCL 13H

A sample lot of seamless polyester film belts from an alternate source were provided. Tests were conducted on the alternate source belts under conditions which duplicated tests performed as part of an earlier study of fatigue life of belts. It was found that the alternate source belts had a significantly longer life than did the control group belts. It was determined that the variability of life within each sample lot does not differ significantly between samples. The alternate source belts may be expected to have a life approximately four times that of the control group belts when used under identical conditions. Author

N68-15635# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MEASUREMENT OF MAGNETIC FIELD INDUCTION COMPONENTS IN THE GAP OF AN INDUCTION PUMP [IZMERENIYE SOSTAVLYAYUSHCHIKH INDUKTSII MAGNITNOGO POLYA V YAYORE INDUKTSIONNOGO NASOSA]
L. Ya. Ulmanis 24 Jul. 1967 14 p refs Transl. into ENGLISH from Riga. Vopr. Magnitn. Gidrodinam. (Russia), 1963 p 153–159
(FTD-HT-67-473; AD-662758)

It is noted that the magnetic field in the inductor of an induction pump consists of a travelling and a pulsating component. An expression (derived elsewhere by G. I. Shturman) is given for the distribution of the induction B in the clearance of an induction

motor with closed magnetic drive. The author points out that in a test coil, placed in the clearance of an induction pump, a voltage is induced from the travelling as well as from both pulsating components of the induction. This phenomenon is examined in detail in the article on the basis of the Faraday law. It is shown that the induction of a travelling magnetic field can be measured by separating the two components of the pulsating field by means of three coils, with one of the coils placed in the center of the inductor and the other two placed symmetrically with respect to the first in the position y sub 0 = (2k + 1) tau/2. The symmetrical coils are connected in series with one another and in opposition to the center coil. The coil parameters necessary for compensation of the pulsating component are indicated, and the limitations of this method of measuring the inductance of a travelling magnetic field are noted. For the measurement of the distribution of the travelling component of the inductance, two pairs of coils are required, each pair being placed symmetrically with respect to the center of the inductor and interconnected in a congruent manner. One coil pair is used to measure the travelling component and the second pair to compensate for the pulsating component of the induction, distributed according to the hyperbolic cosine law. TAB

N68-15648# Naval Ship Research and Development Center, Annapolis, Md. Marine Engineering Lab.
THEORETICAL VIBRATION STUDY OF THE BEARING ANALYSIS MACHINE
Thomas L. Daugherty Washington, D. C. Dec. 1967 48 p refs
(Rept.-2486; AD-662685)

The Bearing Analysis Machine is a tool for the study of bearing-generated vibrations. It is used for Navy quiet bearing inspection and as a research tool. Analysis of two mathematical models determines the theoretical rigid-body, outer-ring response of the test bearing to forcing functions generated by both the machine components and the test bearing. The bearing outer-ring response per pound of forcing function was calculated for a Size 314 bearing under 100-pounds thrust load to illustrate the results for frequencies of 10 to 10,000 hertz. The results indicated greater bearing response to bearing-generated forces than to machine-generated forces. Therefore, for forcing functions of the same order of magnitude, the major contribution to the measured spectrum would result from bearing-generated forces. Author (TAB)

N68-15676* Harvey Aluminum, Torrance, Calif.
RESEARCH PROGRAM TO DEVELOP A TECHNOLOGY IMPROVEMENT PROGRAM FOR CLOSED DIE FORGING Final Report
[1968] 129 p refs
(Contract NAS8-20093)
(NASA-CR-61487; HA-2288) CFSTI: $3.00 CSCL 13H

Engineering drawings and specifications are presented for closed die forging, and a bibliography is also included. N.E.N.

N68-15717*# Westinghouse Electric Corp., Pittsburgh, Pa. Material Dept.
OUT-OF-VACUUM ELECTRON BEAM WELDING Technical Program Summary, Mar. 1966–Apr. 1967
L. G. Stemann 15 Jun. 1967 68 p refs
(Contract NAS8-11929)
(NASA-CR-61463; WANL-L-199) CFSTI: HC $3.00/MF $0.65 CSCL 13H

The operating characteristics and penetration limitations of the Out-of-Vacuum Electron Beam Welder are described. Using this equipment, operating parameters and their effects at high power input levels were explored to further define overall process capabilities. The maximum weldable thickness, while maintaining a practical latitude in weld speed and energy control requirements, was established as approximately 0.712 inches. Radiographic quality could not be achieved in these heavier materials but reduction in weld speed to very low values (10–12 inches/min) did produce considerable improvement in 1/2 inch plate. Tensile and bend testing were conducted on a series of welds produced with these conditions. Author

N68-15794*# Boeing Co., Seattle, Wash. Aerospace Group.
IDENTIFYING OPTIMUM PARAMETERS OF HOT EXTRUSIONS Progress Report, 18 Oct. 1967–11 Jan. 1968
11 Jan. 1968 32 p
(Contract NAS7-276)
(NASA-CR-92543; PR-15) CFSTI: HC $3.00/MF $0.65 CSCL 13H

Six extrusions were attempted, three of which were successfully extruded. One successful and one stalled extrusion having MgO powder insulation showed that low (less than 20% dense) powder densities led to non-uniformities. However, results indicate that the "insulation" lowers the heating required for extrusion and reduces the resultant grain size. Analyses also indicate that forging of specimens prior to extrusion reduces grain size. It is confirmed that ZrO_2 and CaO are extrudable at lower temperatures than MgO, and that ZrO_2 also rapidly recrystallizes. Additives to ZrO_2, such as CaO, appear to speed recrystallization and slow decomposition. Extruded MgO crystals show a pseudo-crystal texture. Extruded ZrO_2 appears to have a (100) axial texture (like that of MgO and CaO) which is destroyed by recrystallization and grain growth. Use of steel shells on the outside of extrusions appears promising to reduce the volume of refractory metal and allow better lubrication. However, graphite cannot replace the refractory metal. Author

N68-15880# Mitsubishi Heavy Industries, Ltd., Nagasaki (Japan).
PITTING RESISTANCE AND ACCURACY OF TUFFTRIDE TREATED OR SULFINUZ TREATED SPUR GEAR
Daizo Sunamoto (Kobe Tech. Inst., Japan), Tadayoshi Endo (Kobe Tech. Inst., Japan), and Yoichi Omura (Kobe Tech. Inst., Japan) 1967 9 p refs In JAPANESE; ENGLISH summary
(MTB-010047)

Several pitting tests of Tuffride treated or Sulfinuz treated spur gears which have 4mm module, 10mm tooth width, 23 and 37 teeth, were carried out by a torque circulating gear testing machine. And also the change of gear accuracy was checked after the treatments. Test results were summarized as follows: (1) The change of the gear accuracy by the two heat treatments was very little, comparing with that before the treatments. (2) These test methods which are Wöhler method, FZG method and step-up method, were carried out to determine the pitting resistance of the gears. And pitting resistance obtained by FZG method or step-up method were on the safe side comparing with those of Wöhler method. (3) The pitting resistances of low alloy steels increased about 100% by Tuffride treatment while those of low carbon steel increased about 50% by Tuffride treatment or Sulfinuz treatment. (4) Relationship between surface hardness (H_B or H_V) and the pitting resistance (σ_{max}) of gears which were obtained with the experimental condition, are shown as follows: $\sigma_{max} = (0.2 \sim 0.25) H_B$ or $(0.19 \sim 0.23) H_V$ (kg/mm^2). Author

N68-16023* Tracerlab, Inc., Waltham, Mass.
ENCAPSULATION OF RADIOACTIVE MATERIAL FOR SPACE APPLICATIONS Final Report
Richard C. Fix, P. F. Russo, and Harold B. Carter [1967] 63 p refs
(Contract NAS5-9343)
(NASA-CR-91907) CFSTI: $3.00 CSCL 13H

Source encapsulation techniques were developed which permit sources in 10 microcurie to 100 millicurie range to completely contain the radioactive material during 1–5 year exposure to the space environment. Environmental conditions and source tests were developed, and criteria were stated for material selection. Alpha, beta, gamma, X-ray and conversion electron sources were fabricated using polyimides and or metal. These sources were tested for resistance to shock, abrasion, humidity and temperature cycling (−60°C to 100°C at pressures less than 10^{-5} torr) after irradiation to 2×10^{8} rads and were found to retain their integrity. A handbook for encapsulation of radioactive material for space applications was prepared. Author

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N68-15302# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE TERMINAL METHODS OF LASER PUMPING [TEPLOVYYE METODY VOZVUZHDENIYA LAZEROV]
N. G. Basov, A. N. Orayevskiy, and V. A. Shcheglov 13 Jun. 1967 23 p refs Transl. into ENGLISH from Zh. Tekhn. Fiz. (Leningrad), v. 37, no. 2, 1967 p 339–348
(FTD-HT-23-699-67; AD-662245)

Methods of rapid adiabatic cooling of gas systems are discussed for the purpose of obtaining conditions with inverse population density. A series of concrete gas systems suitable for obtaining in them inversion with the aid of heat pumping is shown. The possibility of creating a quantum generator in the infrared region with the use of a molecule gun is considered. TAB

N68-15828# Library of Congress, Washington, D. C. Aerospace Technology Div.
CARBON DIOXIDE AND MOLECULAR BEAM LASERS Surveys of Foreign Scientific and Technical Literature
8 Dec. 1967 160 p refs *Its* Work Assignment No. 14
(ATD-68-84-14-2; Rept.-1; AD-662637)

Contents: Attainment of negative temperatures by heating and cooling of a system; Negative absorption in a nonequilibrium hydrogen plasma; Radiation enhancement in a recombining plasma; Population inversion obtained by thermal dissociation of molecules in a shock wave; Beam laser for the infrared band; Cooling of free electrons in a plasma; A mechanism ensuring level population inversion in CO2 lasers; Rapid recombination of plasma jets; Population inversion in adiabatic expansion of a gas mixture; Influence of rate of disintegration of the lower laser level on the power of a CO2 laser; Thermal methods of laser pumping; CO2 lasers; Powerful gas lasers; Stimulated Mandelshtam-Brillouin scattering in carbon dioxide in the vicinity of the critical point. TAB

N68-15956# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPERIMENTS WITH GAS LASERS [OPYTY S GAZOVYMI LAZERAMI]
N. I. Kaliteyevskiy, A. N. Razumovskiy, M. P. Chayka, and V. A. Cherenkovskiy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 47–54 refs (See N68-15951 06-06)

The intensity of generated power (stimulated radiation) as a function of the input, the diameter of the discharge tube, and of the gas pressure was investigated in experiments with a helium-neon optical maser operating on a wavelength of 1.15 μ corresponding to the 2s-2p transition in neon. The contribution to radiation of the various parts of the discharge, and the structure of the generated beam were studied. Results indicate that the intensity of the generated beam reaches a maximum with increase of the input power, and then decreases. L.S.

N68-15980# Aircraft Armaments, Inc., Cockeysville, Md.
STUDY OF LASER APPLICATION TO VELOCITY MEASURING SYSTEM, PHASE 9 Final Report
M. C. Watkins Apr. 1967 38 p
(Contract AF 29(600)-4136)
(ER-4889; MDC-TR-67-136; AD-662342)

The report summarizes results of the feasibility study phase utilizing a laser doppler system for determining high accuracy velocity and acceleration profiles of high speed rocket sleds. The report also presents recommendations and specifications for an operational laser velocity measuring system. Objectives of the study phase were twofold: the first and primary one being the implementation and testing of a laser doppler velocity measuring system. Construction of the experimental breadboard incorporated designs and modifications which were dictated by earlier experimental results and the latest state-of-the-art techniques; the second objective was the design, fabrication and testing of a laser beam steering control which would enable the transmitted laser energy to be concentrated on a sled-mounted retroreflector during sled travel. Author (TAB)

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N68-15048 Technische Hochschule Hannover (West Germany).
ON THE NATURE OF MARTENSITE-AUSTENITE REMODIFICATION IN AN Fe-Ni-ALLOY WITH 32.5% Ni [UEBER DIE NATUR DER MARTENSIT-AUSTENIT-RUECKUMWANDLUNG IN EINER Fe-Ni-LEGIERUNG MIT 32,5 % Ni]
Hans Kessler (Ph.D. Thesis) 1966 134 p refs In GERMAN

Crystallographic studies on the martensite-austenite phase transformation in an iron alloy containing 32.5% nickel, together with tape recorded sounds during rearrangement, established a shearing mechanism similar to martensitic formation at a temperature region of 300 to 430°C. Microcalorimetric analyses during low temperature phase transformation found a required temperature of 530°C for complete rearrangement of the martensitic structure; phase transformation during the low temperature process was marked by diffusive nucleation and growths. Transl. by G.G.

N68-15090# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

PROBLEMS OF INVESTIGATING THERMOELECTRODE ALLOYS, STABLE TO OXIDATION UP TO 2000°C [PROBLEMY IZYSKANIYA TERMOELEKTRODNYKH SPLAVOV, STOYKIKH PROTIV OKISLENIYA DO 2000°C]

I. A. Aleksakhin, I. R. Lepin, and B. K. Bragin 2 Aug. 1967 26 p refs Transl. into ENGLISH from Issled. Splavov Dlya Temopar (USSR), no. 2, 1964 p 143–158 (FTD-HT-23-746-67; AD-662573)

The possibility of developing a thermocouple capable of measuring temperatures up to 2000C in oxidizing media and in air was studied. Only alloys based on Ir are suitable for such thermocouples. A review is given on work done on the development of high-temperature thermocouples performing in oxidizing media. The thermocouple Ir-60Rh/Ir, suitable for measuring temperatures up to 2000C for 10-20 hrs. in air was the best of the known thermocouples. Data for heat resistance, phase compn. of Ir alloys, and properties of pure metals indicate that good thermoelectric properties and high stability can be found in alloys of Ir with Rh, Pt, Pd, and Au. Alloys of Ir with nonnoble metals, and complex alloys based on Ir can also be used. TAB

N68-15108# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

CYCLIC DEFORMATION OF NEUTRON IRRADIATED COPPER

R. B. Adamson Oct. 1967 23 p refs (AERE-R-5595)

Copper single crystals irradiated to a neutron dose of 1.1×10^{18} n/cm^2 (>1 MeV) have been cycled between constant plastic elongation limits at room temperature. The general cyclic deformation characteristics have been ascertained and some qualitative ideas on the mechanisms of deformation developed. Transmission electron microscopy reveals that channels completely free of irradiation-produced defects are created during the cyclic strain program. The width and spacing of the channels have been shown to be a function of the number of cycles. An electron microscope shadowgraph technique has also been used to study the exact shape and distribution of surface slip steps and the results are compared to the channel observations. Author

N68-15113# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

A FIELD-ION MICROSCOPE STUDY OF THIN FILMS OF IRIDIUM ON MOLYBDENUM

D. S. Whitmell Oct. 1967 21 p refs (AERE-R-5608)

The deposition of thin films of iridium on molybdenum has been studied by field-ion microscopy. When the substrate was held at low temperature during and after deposition, a localised thin deposit coherently bound to the substrate was formed. At higher substrate temperatures, diffusion of the iridium took place, and thicker films were grown epitaxially on the substrate with (111) Ir// (110) Mo and [To1] Ir// [$\bar{1}$1$\bar{1}$] Mo. Twin crystals caused by multiple positioning, and stacking faults, were found. There was no evidence of alloying by surface diffusion. Author

N68-15207# Naval Ordnance Lab., White Oak, Md. Explosion Dynamics Div.

SHOCK-INDUCED TRANSFORMATIONS OF TITANIUM NICKEL ALLOY

N. L. Coleburn 1 May 1967 33 p refs (NOLTR-67-78; AD-653080)

The report describes the behavior under shock wave compression of three compound alloys of titanium and nickel. Explosive-propelled metal plates transmitted pressures of up to 0.8 megabar in specimens with 50.3 atomic % Ni, 51.4 atomic % Ni, and 55.0 atomic % Ni. Shock wave and free-surface velocities were measured optically. The corresponding compression points were determined from the Rankine-Hugoniot equations. The data reveal that the dynamic compressibilities of Ti–Ni alloys are sensitive to temperature changes. At 90 kbars the microstructure of the near stoichiometric 50.3 atomic % Ni undergoes an almost complete martensitic transformation. The transformation is less evident in 51.4 atomic % Ni. The 55.0 atomic % Ni alloy is unchanged by the 90-kbar shock. At 270–280 kbars the shock velocity in stoichiometric Ti–Ni specimens, initially at 15C, becomes insensitive to pressure. The formation of a new phase is indicated. Author (TAB)

N68-15309# Royal Aeronautical Society, London (England). Technical Dept.

MATERIAL PROPERTIES HANDBOOK. VOLUME 3. MAGNESIUM NICKEL AND TITANIUM ALLOYS

Feb. 1963 280 p Prepared for AGARD (AD-662162)

For each distinct alloy or group of alloys a set of charts is given which include, for various forms and conditions of the alloy, information on the chemical composition and physical and mechanical properties at room and at elevated temperatures. A complete list of the properties covered is given at the end of these notes. For some of the alloys dealt with, the complete range of data is not yet available. Author (TAB)

N68-15355# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

REFRACTORY METAL ALLOY RESEARCH AND DEVELOPMENT

E. S. Funston and C. O. Tarr *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 71–77 refs (See N68-15351 06-22)

Process development of weldable, ductile Mo to provide nuclear quality bar, sheet, and seamless tubing is reported, as is the processing of various W–Re–Mo alloys and their weldability. Seventy-one extrusions were completed, including 44 of W–25 Re–30 Mo, 14 of W–30 Re–30 Mo, and five of purified Mo. Results are tabulated for the radiographic and metallographic examination of electron beam welds for microporosity at edges of the weld fused area for sheets of W–25 Re, W–25 Re–30 Mo, and W–30 Re–30 Mo; and processing of refractory metal sheets is discussed. M.W.R.

N68-15356# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

EVALUATIONS OF THE PLASTIC FATIGUE PROPERTIES OF HEAT RESISTANT ALLOYS

J. B. Conway *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 79–89 ref (See N68-15351 06-22)

Parameters affecting low cycle fatigue life of metals and alloys at elevated temperatures are being studied in order to generate low cycle fatigue test data for use in designing structural components of high performance nuclear reactor systems. Temperature, strain amplitude and rate, and length of hold times at peak strain in each cycle are being investigated for AISI steels 304, 316, and 348. Metallurgical and fracture mechanics are also reported, and macrofractographs are shown for six stainless steel specimens. Type 348 stainless steel fatigue specimen fracture mode

characterization is tabulated, as are results of room temperature VHN hardness measurements for these specimens tested under low cycle fatigue conditions at 650° and 816°C. M.W.R.

N68-15358# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
ADVANCED PRESSURE VESSEL MATERIALS
F. C. Robertshaw and H. R. Stephan *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 109–122 refs (See N68-15351 06-22)

High strength steels and alloys are being studied for possible use in nuclear reactor pressure vessels; and plate materials under investigation include a 12 Ni–5 Cr–3 Mo maraging steel, a precipitation hardening steel PH13–8 Mo, and Inconel alloy 718. Tables detail the composition of these materials, as well as the Charpy V orientations and tensile blanks used in two irradiation experiments. Tensile properties are given at various temperatures for each of the alloys, and Charpy V notch impact strengths are tabulated. M.W.R.

N68-15359# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
HIGH TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS
J. F. White and E. F. Juenke *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 123–133 refs (See N68-15351 06-22)

High temperature physico-chemical properties of refractory carbides were studied for possible fuel and structural applications. Preparation and fabrication of refractory carbides of Hf, Ta, and Zr are discussed. Thermal stability and effect of strain on lattice parameters are considered for TaC; and X ray diffraction and chemical analyses of carbides produced from the metal oxides in vacuum are tabulated. Densities of various carbide compacts prepared by vacuum hot pressing are given, as are diffusion coefficients for carbon in TaC_{1-x}. Nonstoichiometry in Ta and U monocarbides is discussed, and chemical and X ray analyses are tabulated for the tantalum carbide compositions used in equilibration experiments. Carbon activity is shown as a function of temperature and composition in TaC_x and as a function of temperature and composition in $UC_xO_{.099}$. M.W.R.

N68-15362# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
PHYSICAL METALLURGY OF REFRACTORY METAL ALLOYS
C. G. Collins. *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 153–161 refs (See N68-15351 06-22)

Phase stability, composition variations, impurity concentrations, and effects resulting from self-diffusion and vaporization processes were studied for refractory metal alloys of the W–Re–Mo system. Recrystallization, aging, and brittle-to-brittle transition temperatures of these alloys were investigated. M.W.R.

N68-15480# Air Force Systems Command, Wright-Patterson AFB, Ohio. Air Force Materials Lab.
SUPERALLOY FIBERS: MECHANICAL PROPERTIES VERSUS DRAWING TECHNIQUES
Jack H. Ross Sep. 1967 25 p refs Presented at the 96th AIME Ann. Meeting, Los Angeles, 19–23 Feb. 1967
(AFML-TR-67-171; AD-662871)

An investigation was made of the mechanical properties of yarns formed by the modified Levi process (encasement of each fiber in a matrix followed by encasing the whole bundle in the same matrix) and the Air Force-Hoskins process (enclosure of the entire bundle of fibers in a dissimilar alloy ribbon). As a base point in evaluating the fiber and yarn mechanical properties, data on single-drawn superalloy fibers are analyzed for comparison. The results of this analysis reveal that the properties of two types of multidrawn yarns when formed from an alloy similar to Chromel R are very comparable. The major differences noted are that one (the modified Levi process 90 end yarn) has broken filaments which are tied into the structure by the use of excessive twist (up to 19 turns per inch) and the other (the Air Force-Hoskins process 100 end yarn) has some interfilament welding and a rough fiber surface which without a coating will cause abrasive action in the yarn and thus loss in strength. Author (TAB)

N68-15553# Naval Research Lab., Washington, D. C.
FRACTURE DEVELOPMENT AND MATERIAL PROPERTIES IN PVRC–PENN STATE PRESSURE VESSEL Final Report
L. A. Cooley and E. A. Lange Oct. 1967 26 p refs
(NRL-MEMO-1827; AD-663203)

A characterization of materials was conducted in relation to the terminal, burst-type, failure of a PVRC pressure vessel in A212A steel at 110F. Materials were characterized with respect to chemical composition, tensile properties, fracture toughness including Charpy-V and Tear Energies, Drop-Weight NDT, micrography and electron fractography. The initiation and growth of a 34-in. long fatigue crack was shown to be caused by mechanical aspects rather than material deficiencies and the plastic instability burst, brittle run, and crack arrest were in complete accord with the Fracture Analysis Diagram. Author (TAB)

N68-15556# Brown Univ., Providence, R. I. Engineering Div.
A NOTE ON YIELD CURVES IN CYCLIC WORK SOFTENING
W. R. Powell Nov. 1967 42 p refs
(Contract ARPA SD-86)
(ARPA-E52; AD-663182)

Cyclic work softening is a transient behavior which occurs at the beginning of fatigue tests and reduces the mechanical strength of the material. Softening is likely to occur in hard materials under low cycle fatigue conditions. A method is described by which cyclic softening or hardening can be predicted from the monotonic properties of the material. The mechanisms which produce softening are not completely understood but appear to vary depending on the mechanisms which produce the hardening of the material. Since cyclic softening is an unstable behavior, it cannot be described by any stable material models. Tests on 1100-H14 aluminum indicate that the material softens under cyclic torsion and that the softening causes only a very small reduction in the tensile strength. Author (TAB)

N68-15572*# Lockheed Nuclear Products, Marietta, Ga.
EFFECT OF NUCLEAR RADIATION ON MATERIALS AT CRYOGENIC TEMPERATURES
C. A. Schwanbeck Aug. 1967 140 p refs
(Contract NAS3-7985)
(NASA-CR-72332; LAC-ER-9757) CFSTI: HC $3.00/MF $0.65 CSCL 11F

This report describes the result of a test program investigating the effects of cryogenic and combined nuclear–cryogenic environments on the mechanical properties of several metals and alloys. The effects on tensile properties of strain hardened polycrystalline high purity aluminum, commercially pure titanium, titanium–5 aluminum–2.5 tin, and titanium–6 aluminum–4 vanadium

are reported in detail. The titanium–5 aluminum–2.5 tin was tested at two levels of interstitial content; the titanium–6 aluminum–4 vanadium was tested in both the annealed and the aged conditions. Effects on the fatigue behavior under high load, low cycle rate loading conditions, are reported for commercially pure titanium and titanium–5 aluminum–2.5 tin. In all cases, unirradiated room temperature control specimen were tested and the results are herein reported as reference data. Author

N68-15575# Westinghouse Electric Corp., Pittsburgh, Pa. Astronuclear Lab.

PREPARATION AND CHARACTERIZATION OF HIGH QUALITY SINGLE CRYSTAL REFRACTORY METAL CARBIDES Technical Report, Apr. 1966–Apr. 1967

J. M. Tobin and L. R. Fleischer Wright-Patterson AFB, Ohio AF Mater. Lab. Oct. 1967 77 p refs

(Contract AF 33(615)-3982)

(AFML-TR-67-137, Pt. 1; AD-663248)

A process for growing single crystals of ZrC was developed. The crystals are grown by direct reaction of the elements at very high temperatures. Process yields of crystals measuring 0.28 inch diameter and over 0.5 inch long are high. Eighty percent of the starting rods will produce a crystal. The resulting crystals are characteristically free of microscopic pores and inclusions. After prolonged heating, the crystals are found to be homogeneous (49.4 atomic percent carbon) and free of strain. The lattice parameters vary among crystals between 4.6996 to 4.6999 Angstrom units. The crystals are randomly oriented with respect to their axes. They are readily cleaved on the (100) plane of the crystals. Absence of strain is indicated by the flatness of the cleavage plane faces. Sub-grain boundaries are observed infrequently. Each step in the multiple-step time and temperature program used to produce the crystals was analyzed to yield an understanding of the crystal growth mechanism. The crystals grow by a solid state recrystallization mechanism which is initiated by plastic strain. The feasibility of the use of the technique to grow crystals of HfC, TaC, NbC and VC was demonstrated. Crystals of HfC were grown, but the crystals are small and the yield is low. Development continues. Polycrystalline TaC, Ta2C and W2C was produced in rod diameters from 0.25 to 0.5 inches. The two sub-carbides were produced as single-phased carbide. But the structures are severely cracked. Development of the direct reaction process applied to solid transition metals continues. Author (TAB)

N68-15637*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

APPLICATION OF DIRECTIONAL SOLIDIFICATION TO A NASA NICKEL-BASE ALLOY (TAZ-8B)

John C. Freche, William J. Waters, and Richard L. Ashbrook Washington Feb. 1968 22 p refs

(NASA-TN-D-4390) CFSTI: HC $3.00/MF $0.65 CSCL 11F

A nickel-base alloy (TAZ-8B) has been developed which compares favorably in high-temperature strength with known high-strength nickel-base alloys. Although basically a cast material, the alloy also has workability potential. By applying directional solidification techniques, test specimens were produced with a preferred columnar grain orientation. Grain boundaries transverse to the major stress axis were largely eliminated. Substantial increases in ductility, ultimate tensile strength, and stress-rupture life were obtained with the alloy in the directional polycrystalline condition, as compared with the random polycrystalline condition. On the basis of calculated electron vacancy number, TAZ-8B would not be expected to form sigma phase. Only minor decreases in 1400°F (1033°K) ductility were observed after exposure for 1000 hours at 1600°F (1144°K). Tensile elongation decreased from 3.3 to 2.0 percent for the random polycrystalline material and from 6.6 to 6.0 percent for the directional polycrystalline material. The application of directional solidification to TAZ-8B resulted in alloy properties which are of interest for potential advanced gas turbine engine applications. Author

N68-15646# Naval Research Lab., Washington, D. C.

METALLURGICAL CHARACTERISTICS OF HIGH STRENGTH STRUCTURAL MATERIALS Progress Report

R. J. Goode, R. W. Huber, D. G. Howe, R. W. Judy, Jr., T. W. Crooker et al Sep. 1967 162 p refs

(NRL-6607; AD-662189)

The report includes fracture toughness studies on some new titanium alloys as well as results of an initial feasibility study aimed at raising the optimum strength and toughness limits for titanium alloys through an approach involving thick section composites. The results of salt water stress-corrosion-cracking studies on a number of titanium alloys are described including a study concerning the effect of vacuum heat treatment on stress-corrosion-cracking resistance of titanium alloys. Fatigue crack propagation studies in air and in salt water on the pressure vessel steels A302B, A201B, and A517F are discussed; and the results compared to the actual service performance of these same materials in PVRC program studies. Preliminary fracture toughness correlation diagrams are presented for high strength steels based upon fracture mechanics and engineering test methods. The latest versions of the Fracture Toughness Index Diagrams for steels, titanium alloys and aluminum alloys, a usual feature of this report series and which are based upon engineering test methods, are presented and the significance of the features briefly discussed. Fracture toughness studies on thick plates of 5Ni-Cr-Mo-V, and a new 9Ni-4Co steel are reported. In addition, the results are presented for similar studies on welds of 2Mn-2Ni in 5Ni-Cr-Mo-V steels and welds of 9Ni-4Co, 12Ni-3Cr-3Mo and 17Ni-2Co-3Mo compositions. Author (TAB)

N68-15663# Royal Armament Research and Development Establishment, Fort Halstead (England). Basic Techniques Div.

THE INFLUENCE OF COPPER, SILICON AND MANGANESE ON THE STRENGTHENING MECHANISMS IN A MEDIUM CARBON STEEL

A. R. Cox Nov. 1967 29 p refs

(RARDE-MEMO-37/67) CFSTI: HC $3.00/MF $0.65

The influence of the elements copper, silicon and manganese on the strengthening processes in a quenched and tempered medium carbon steel was studied. From data obtained from electron micrographs the strengthening contributions from precipitates, dislocations and interstitials were calculated. Then, using an equation similar to that proposed by Conrad for the strength of iron, the total strength was determined and compared with the experimental 0.2% proof stress. The calculated and experimental values compared favourably, and fully reflected the changes in strength that accompanied tempering. None of the elements significantly affected the Orowan strengthening of the carbides but silicon increased the strengthening due to ε-carbide. In addition, silicon retarded the loss of carbon from solution and maintained significant interstitial strengthening to higher temperatures. In the quenched state the dislocation strengthening in the plain carbon steel was 15 t.s.i. and this decreased to 3 t.s.i. after tempering at 700°C. Similar results were obtained for the alloy steels in the quenched state, but above 500°C, copper precipitated, and retarded recovery. As a result the dislocation strengthening at 700°C was 3 t.s.i. higher than in the plain carbon steel. Copper also contributed to the Orowan strengthening, whilst manganese and silicon increased the strength of the steels tempered at 700°C by solid solution hardening. Author (ESRO)

N68-15707# Air Force Cambridge Research Labs., Bedford, Mass. Terrestrial Sciences Lab.

SHEAR STRENGTH OF TWELVE GROSSLY DEFORMED METALS AT HIGH PRESSURES AND TEMPERATURES Interim Report

R. E. Riecker, L. C. Towle (Naval Res. Lab., Washington, D. C.), and T. P. Rooney Aug. 1967 32 p refs *Its* Environ. Res. Papers, No. 273

(AFCRL-67-0475; AD-662347)

The shear strength of grossly deformed tungsten, germanium, nickel, beryllium, uranium, copper, gold, silver, aluminum, magnesium, bismuth, and tin was measured in an opposed anvil shear apparatus at pressures up to 150 kb at 27C, and for gold, silver, and copper to 900C. The shear data agree with independent strength measurements at low pressures, but differ significantly from high-pressure shear-strength measurements made by other investigators. The data on the noble metals also fit a simple empirical formula relating the temperature and pressure dependence of the shear strength. Author (TAB)

N68-15715*# Case Western Reserve Univ., Cleveland, Ohio. Dep. of Metallurgy.

EFFECTS ON HYDROSTATIC PRESSURE ON THE MECHANICAL BEHAVIOR OF BODY CENTERED CUBIC REFRACTORY METALS AND ALLOYS Interim Technical Report

S. V. Radcliffe and G. Das Dec. 1967 49 p refs

(Grant NsG-654)

(NASA-CR-92592) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The pressure dependence of tensile stress–strain behavior of recrystallized powder metallurgy tungsten at room temperature and constant strain rate has been extended to environmental pressures up to 11 kilobars. The substructures developed during plastic straining at high pressure differ with respect to dislocation distribution and density from those for polycrystalline tungsten subjected to similar amounts of plastic strain at higher temperature at atmospheric pressure or single crystals at room temperature. Corresponding to the initiation of plastic yielding, the reduction in area at fracture increases progressively with pressure but with no indication of a brittle-ductile transition up to the highest pressure examined. Fracture occurs by a combination of intergranular and transgranular cleavage over the whole pressure range. At the highest pressure, 11 kilobars, cracks develop but propagate only slowly. The relevance of these various observations to current understanding of flow and fracture in tungsten is discussed. Author

N68-15736*# Tyco Labs., Inc., Waltham, Mass.

LEAD TELLURIDE BONDING AND SEGMENTATION STUDY Interim Report, 1 Nov. 1966–31 Jul. 1967

H. Bates, F. Wald, and M. Weinstein 31 Jul. 1967 143 p refs

(Contract NAS5-9149)

(NASA-CR-91791; IR-2) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Constitutional investigations of telluride systems, bonding studies, couple design and testing, test devices, and life testing are reported for lead telluride bonding and segmentation. Cobalt and rhenium PbTe and SnTe systems were studied, as was the use of Co–Sn–Te alloys as brazes for thermoelectric materials. An estimation of the reactivity of PbTe and SnTe with elemental metals is included. Surface finish effect on bonding is considered; as are hydrogen treatment of 3P elements, plasma spraying of W and 3P, and tungsten diffusion bond. Both segmented Si–Ge–PbTe and PbTe couples were investigated, along with life testers for both and an element tester water safety control system. Two gradient life tests are described, and isothermal testing at 525°C and testing of W-bonded 3N and 3P at 600°C are reported. M.W.R.

N68-15805*# Case Western Reserve Univ., Cleveland, Ohio. Dept. of Metallurgy.

THE EFFECT OF DEFORMATION ON DISPERSION HARDENED ALLOYS Final Report

G. S. Doble, L. Leonard, and L. J. Ebert Nov. 1967 111 p refs

(Grant NGR-36-003-084)

(NASA-CR-92510) CFSTI: HC$3.00/MF$0.65 CSCL 11F

The elevated temperature tensile properties of TD Nickel were measured after mechanical working and recrystallization treatments. Increases in strength were produced by cold swaging while upset forging or prior torsion lowered the strength. Recrystallization to a coarse grain size increased strength over the fine grained cold worked bar stock. Intercrystalline cracking was the controlling mechanism for elevated temperature strength of recrystallized TD Nickel. Evidence for a similar mechanism in fine grained TD Nickel is discussed. The development of a recrystallization resistant structure in TD Nickel was shown to depend upon the deformation history. No recrystallization took place after cold swaging reductions of 15–95% while the occurrence and extent of recrystallization after a given cold rolling reduction varied with the rolling direction. Recrystallization resistance was accompanied by the development of relatively sharp crystallographic textures. Author

N68-15895# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SOFTENING OF CAST IRON BY IRRADIATION WITH NEUTRONS

Ye. A. Markovskiy and M. M. Krasnoshchekov 3 Aug. 1967 8 p Transl. into ENGLISH from Liteinoe Proizn. (Moscow), no. 6, 1966 p 32

(FTD-HT-23-549-67; AD-662789)

Groups of specimens of malleable cast iron, annealed for 34 hr at 970C, were exposed to integral fluxes of 10 to the 16th power, 10 to the 17th power, 10 to the 18th power, 10 to the 19th power, and 10 to the 20th power neutrons/sq. cm in a water-moderated water-cooled reactor. Before and after the irradiation the specimens were tested for linear wear W, friction coefficient mu and temperature t of the lubricant emerging from the friction zone. Vickers hardness, and microhardness. The wear tests showed that W, mu and t are hardly affected by irradiation. Hardness, as a yardstick of plastic deformation, is a characteristic of the wear resistance of materials. The pattern of variation in the hardness of the irradiated malleable and high-strength cast irons resembles the pattern of variation in their wear resistance. Thus hardness decreases following the irradiation of malleable cast iron with insignificant neutron fluxes (10 to the 17th power -10 to the 18th power neutrons/sq cm) but increases again as the neutron dose is increased. A similar pattern of variation in microhardness is observed. Thus, irradiation is accompanied by two simultaneous processes: softening of the material due to the weakening of grain boundaries and hardening of the crystal lattice in proportion to the number of the bombarding fast neutrons. As irradiation time increases, the hardening process begins to predominate. TAB

N68-15988# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF METALS

Aleksander Krupkowski *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 62–67 refs (See N68-15982 08-34)

Continuing research on basic problems of metallurgy are briefly reported. Equilibrium and kinetics of metallurgical processes in liquid solutions and phase transformations in the solid state are mentioned. Investigations in the plastic deformation and magnetic properties of pure metals and alloys are described. N.E.N.

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N68-15109# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

IRRADIATION DAMAGE AND IRRADIATION HARDENING IN SINGLE CRYSTAL MgO AFTER LOW NEUTRON DOSES

R. W. Davidge Oct. 1967 20 p refs

(AERE-R-5610)

MgO crystals containing <5000 ppm Fe were heat treated in various ways, to control the form of the iron (Fe^{2+} or Fe^{3+}), and then irradiated to doses (ϕ) $<10^{18}$ nvt (>1MeV). The critical resolved shear stress, (CRSS) the optical absorption spectrum and the lattice parameter were measured as a function of dose and of post-irradiation annealing. The increase in CRSS varies as $A\phi^{1/2}$ where A is a constant. A is greatest when iron in Fe^{2+} form is present, and increases with increasing iron content. The hardening is more resistant to annealing when Fe^{2+} is present. No simple correlations exist between the hardening and either the concentrations of colour centres or the lattice parameter changes. A speculative model is presented for the observed behaviour. Author

N68-15148 Technische Hochschule Hannover (West Germany).

RESEARCH ON THE THEME: ELECTRICAL CONDUCTIVITY OF VULCANIZATES UNDER THE INFLUENCE OF MECHANICAL STRESS AND TEMPERATURE [UNTERSUCHUNGEN ZUM THEMA: ELEKTRISCHE LEITFAEHIGKEIT VON VULKANISATEN UND IHRE BEEINFLUSSUNG DURCH MECHANISCHE BEANSPRUCHUNG UND TEMPERATUR]

Konrad Ziermann (Ph.D. Thesis) 1966 166 p refs In GERMAN

Studies and experiments were conducted to determine the effects of temperature, mechanical stresses, and atmospheric degradation on the electrical conductivity of rubber–carbon black vulcanizates. The results were evaluated for dc properties of vulcanizates and for changes caused by vulcanization, static loads, and swelling. Special surface electrodes were designed to measure the electric potential flow in the test specimens. Transl. by K.W.

N68-15170# Franklin Inst., Philadelphia, Pa. Research Labs.

DETERMINATION OF THE EFFECTIVE ELASTIC PROPERTIES FOR BIAXIALLY FIBER REINFORCED MATERIALS Final Report

Z. Hashin, M. A. Brull, T. Y. Chu, and Z. Zudans Ft. Eustis, Va. Army Aviation Materiel Labs. Aug. 1967 164 p refs

(Contract DA-44-177-AMC-351(T))

(F-B2455; USAAVLABS-TR-67-41; AD-662774)

Upper and lower bounds on the effective elastic properties of biaxially fiber reinforced material are derived. Two geometric models for the composite have been considered, and results are presented for several practical materials. In addition, bounds on the components of the shell stiffness tensor are obtained in terms of the bounds of the elastic moduli. Author (TAB)

N68-15292# Naval Radiological Defense Lab., San Francisco, Calif.

IGNITION HARDENING OF CELLULOSIC MATERIALS

Norman J. Alvares and Thomas H. Anderson 26 Dec. 1967 49 p refs

(USNRDL-TR-67; AD-663086)

The ignition response of blackened alpha-cellulose and cotton cloth, containing fire retardant additives, was compared to the ignition response of these materials without additives. This information was obtained by exposing the samples to various irradiance levels from a calibrated thermal radiation source. Samples treated with retardant compounds which showed the most promise were then isothermally pyrolyzed, in air, so that comparisons between the pyrolysis rates of the samples could be obtained. These comparisons yielded further insight into the mechanism of thermal degradation. Similar ignition response measurements were made with specimens exposed to ionizing radiation. Alpha-cellulose samples containing a mixture of boric acid, borax, and ammonium di-hydrogen phosphate could not be ignited by irradiances up to 4.0 cal/sq cm/sec. Above this value, transient ignition would occur but flaming would last only until the ignitible gases were exhausted from the samples. Cotton cloth containing a polymeric retardant with the designation THPC + MM was found to be ignition resistant below an irradiance of 7.0 cal/sq cm/sec. Comparison of the pyrolysis rates of the retardant treated alpha-cellulose and cotton showed that the retardant mechanism is qualitatively the same. It was also found that gamma radiation results in ignition retardance of cellulose, while irradiation by neutrons, does not. Author (TAB)

N68-15374# United Kingdom Atomic Energy Authority, Harwell (England). Research Group.

INTERNAL STRAIN AND THE STRENGTH OF BRITTLE MATERIALS

R. W. Davidge and G. Tappin Oct. 1967 11 p refs

(AERE-R-5603)

The theory of Clarke (Acta Met. 12, 139 (1964)), for the formation of grain boundary cracks in anisometric polycrystalline materials, is re-examined in the light of recent experimental data. The theory predicts correctly the conditions for the formation of grain boundary cracks of length similar to a grain dimension. However, the theory cannot be used to explain the experimentally observed strength/grain size and strength/irradiation dose relationships, for example for BeO. The theory supposes that the process controlling catastrophic fracture is the growth of a crack from a grain boundary pore with an energy absorption rate corresponding to the grain boundary surface energy of $\approx 10^3$ erg/cm^2. In practice, the process controlling catastrophic fracture is the subsequent growth of a crack from a grain dimension, with a higher energy absorption rate corresponding to an effective surface energy of $\approx 10^4$ erg/cm^2. Author

N68-15423 Royal Aircraft Establishment, Farnborough (England).

MULTIPLE IMPACT RAIN EROSION STUDIES AT VELOCITIES UP TO 450 M/S (M 1.3)

R. B. King Jan. 1967 32 p refs

(RAE-TR-67019)

Studies have been made of the rain erosion resistance of a variety of materials at impact speeds up to 450 m/s (1006 mile/hr). The experimental work was carried out on the whirling arm facility at Dornier System, Immenstead, W. Germany. At 450 m/s all the materials examined were seriously damaged in times ranging from 15 s for Perspex to 1 hr for stainless steel under equivalent rainfall conditions. It was shown that the results obtained on the Dornier rig fitted in wall with the results previously obtained at subsonic velocities at the R.A.E. Author

N68-15458# Coast Guard, Washington, D. C. Field Testing and Development Center.

FOAM THERMAL INSULATION

R. E. Buzhardt 13 Nov. 1967 24 p

(Rept.-470; AD-663090)

The report covers the testing of two different types of foam thermal insulation materials using certain proprietary coatings. The purpose of these tests was to determine the suitability of these materials as thermal insulation for shipboard construction considering application methods, surface durability, and degree of fire resistance. None of the material combinations tested met all of the desired specifications. The report describes the test procedures used and the results of the individual tests. Author (TAB)

N68-15667# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A STUDY OF GENERATION IN NONAXIAL DIRECTIONS ON NEODYMIUM GLASS SAMPLES OF CYLINDRICAL FORM [ISSLEDOVANIYE GENERATSII VO VNEAKSIAL' NYKH NAPRAVLENIYAKH NA OBRAZTSAKH NEODIMOVOGO STEKLA TSILINDRICHESKOY FORMY]

V. I. Malyshev, A. S. Markin, and V. S. Petrov 26 May 1967 15 p refs Transl. into ENGLISH from Zh. Prikl. Spectry. (USSR), v. 3, no. 5, 1965 p 415–420
(FTD-HT-66-520; AD-662205)

Results are given of a systematic experimental investigation of laser emission in extra-axial directions. The specimens were cylindrical and square glass rods with semi-reflecting ends and highly polished lateral surfaces. Optically uniform neodymium glass was used. Emission on a wavelength of 1.06 microns was recorded both photoelectrically and photographically. Distribution of radiative energy on the end of the specimen takes the form of rings, with no emission in the axial modes at pumping energies slightly higher than the emission threshold value (20%). Increasing the pumping energy leads to the appearance of more rings with a different emission threshold for each of them. Emission was observed at considerable angles to the axis of the specimants (up to 70 deg.). When the lateral surfaces of the specimens were properly finished, no axial emission was observed even when the pumping energy exceeded the emission threshold by a factor of three. The actual path of the beam within the specimen was determined by studying the distribution of radiative energy in the near and far zones. It was found that the beam follows a closed three-dimensional path within the laser. The time relationship between various points in the far zone was also studied. TAB

N68-15693# Royal Aircraft Establishment, Farnborough (England).

RELATION OF GLASS TRANSITION TEMPERATURE TO MOLECULAR STRUCTURE OF ADDITION COPOLYMERS

J. M. Barton Aug. 1967 51 p refs
(RAE-TR-67187; AD-662536)

An equation is proposed relating the glass transition temperature (TG) of copolymers to the molecular structure in terms of the mole fractions of the various diad sequences of monomer units combined in the copolymer chains. The equation, which can account for the occurrence of a maximum or a minimum in plots of TG versus copolymer composition, is applied to eleven addition copolymer systems and found to give good agreement with the experimental data. Application of the equation to obtain homopolymer TGs by extrapolation is demonstrated. Author (TAB)

N68-15720# Naval Ordnance Lab., White Oak, Md.

HIGH TEMPERATURE RESISTANT MATERIALS FOR MISSILE PROPULSION SYSTEMS Annual Summary Report, Jun. 30, 1966–Jun. 30, 1967

Bruce Hartmann and F. J. Koubek 9 Oct. 1967 29 p refs
(NOLTR-67-146; AD-662679)

Steady state ablation was reached in oxy-acetylene burner tests on extra long specimens of phenolic asbestos. Also tested and analyzed were two densities of foamed silica. Calculation of alpha vs. temperature from experimental data was programmed for a digital computer. A detailed study of the NOL transient calorimeter was made. Generally, the existence of a linear temperature rise on the backface is sufficient evidence that errors are negligible. Author (TAB)

N68-15832# European Organization for Nuclear Research, Geneva (Switzerland).

RADIATION DAMAGE OF MATERIALS. PART 1: A GUIDE TO THE USE OF PLASTICS Engineering Handbook

M. H. Van de Voorde and G. Pluym 11 Nov. 1966 131 p refs
(MPS/INT-CO-66-25) CFSTI: HC $3.00/MF $0.65

The growing need for materials which perform satisfactorily in radiation fields necessitates a guide for the selection of plastics which have to fulfill specific requirements, even when subjected to high doses of absorbed radiation. The general (mechanical, electrical, physical) properties of commercial plastics are given and it is reported on the degeneration of these properties under nuclear radiation. ESRO

N68-15836# European Organization for Nuclear Research, Geneva (Switzerland).

RADIATION DAMAGE OF MATERIALS. PART 2: A GUIDE TO THE USE OF ELASTOMERS Engineering Report

M. H. Van de Voorde 28 Nov. 1966 62 p refs
(MPS/INT-CO-66-27) CFSTI: HC $3.00/MF $0.65

Because of the current use of elastomers in nuclear radiation environments direct guidance is needed for choosing the best elastomers and a summary of unclassified data available in the technical literature on the subject of the effects on elastomers of nuclear radiation. TAB

N68-15840 Entwicklungsring Nord, Bremen (West Germany).

INVESTIGATION OF WEIGHT LOSS AND OPTICAL CHARACTERISTICS OF PLASTIC MATERIAL UNDER THE EFFECT OF GAMMA-RAYS [UNTERSUCHUNG DES GEWICHTSVERLUSTES UND DER OPTISCHEN EIGENSCHAFTEN VON KINSTSTOFFEN NACH EINWIRKUNG VON GAMMA-STRAHLUNG]

H. Nikisch and J. Wolters Bad Godesberg, West Germ. Bundesmin. fuer Wiss. Forsch. Jul. 1967 69 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-14)

Plastics used as construction material for satellite structures are subject to damages by the vacuum and the high power radiation present in space. In this paper the physical behavior of some plastic foils at an ambient pressure of 10^{-6} Torr and γ-radiation is analyzed. Hereby especially the weight loss, the refractive index, the medium dispersion, the optical transparency and the surface roughness are measured as a function of time. The index of refraction n_D and the medium dispersion n_f-n_c did not change up to absorbed quantities of 10 Mrad; however, with some materials the weight losses and with all materials the optical transparency were dependent of the absorbed quantities. Author

N68-15848# Naval Ammunition Depot, Crane, Ind.

SILICONE RESIN SYSTEMS IN ILLUMINATING FLARES

Bernard E. Douda Oct. 1967 33 p refs Supersedes RDTN-123, May 1966
(RDTR-101; RDTN-123 AD-663088)

A commercially available silicone resin was evaluated in the MK 24 AP Flare candle configuration. The silicone resin was

substituted for Laminac 4116 in the formula. At the three percent by weight level, the luminous intensity of the candles containing the silicone resin was about 20 percent less than the MK 24 candle. Future tests are planned to determine why the output degrades. Sensitivity tests on compositions containing the silicone resins were conducted. When 30/50 mesh atomized magnesium is used, the mix is insensitive. The silicone resin system is proposed for use in several other pyrotechnic formulations. Author (TAB)

N68-16063 Joint Publications Research Service, Washington, D. C.
EFFECT OF HIGH-ENERGY RADIATION ON CERAMIC DIELECTRICS
N. S. Kostyukov and T. M. Smirnova 25 Jan. 1968 12 p refs Transl. into ENGLISH from Tr. Gos. Issled. Elektrokeramicheskogo Inst. (USSR), 4 Nov. 1960 p 120–127
(JPRS-44148) CFSTI: $3.00

A data analysis is presented on the effects of high energy γ-radiation on the dielectric properties of ceramic materials. The chemical compositions of the materials are given, along with the possible photonuclear reactions of the component elements. Decay activity curves are plotted, and a graphical analysis of these curves was made to find the half-life of the radioactive components and to obtain an indication of the photonuclear reactions. Measurements of the specific volume resistance were taken before, during, and at the moment of irradiation; the results are tabulated. The temperature dependence of the specific volume resistance was also determined, and the resulting curves are graphed for each material. M.G.J.

N68-16091*# University of Southern Calif., Los Angeles.
STUDY OF SOLUTION PROPERTIES OF BLOCK COPOLYMERS Final Report
L. Utracki and R. Simha 29 Dec. 1967 43 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951836)
(NASA-CR-92545) CFSTI: HC $3.00/MF $0.65 CSCL 11I

Experiments were conducted to determine the solution properties of three vinyl aromatic polymers (PVAr), poly-1-vinylnaphthalene (P1VN), poly-2-vinylnaphthalene (P2VN), and polyvinylbiphenyl (PVB). Instrinsic viscosity and the Huggins parameter of PVAr are tabulated as a function of temperature, and the unperturbed dimensions of PVAr and PS in benzene are given. Dilute solution viscosity and osmotic pressure measurements were made on polystyrene (PS), polybutadiene (PB), a polystyrene–polybutadiene (SB) diblock copolymer and polysterene– polybutadiene–polystyrene (SBS) three block copolymer. Toluene, dioxane, and cyclohexane were chosen as solvents. Tabulations list the characteristics of the polymer samples; the solution properties of homopolymers and block copolymers in the three solvents at 34.2°C; and the interaction parameters. A method, proposed for calculating the interaction parameters of block copolymers in solution, is applied to the intrinsic viscosity data of polymathylmethacrylate–polystyrene block copolymers in benzene and toluene. M.G.J.

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see: 08 Computers.

N68-15040 Technische Hochschule Hannover (West Germany).
CONTRIBUTION TO PRACTICAL SYSTEM ANALYSIS WITH CORRELATION PROCEDURES [BEITRAG ZUR PRAKTISCHEN SYSTEMANALYSE MIT KORRELATIONS-VERFAHREN]
Ernst Bartels (Ph.D. Thesis) 1966 108 p refs In GERMAN Supported in part by German Res. Organ.

Error localization and its influence on the measured cross correlation function are studied for linear systems analysis. Calculations show that a substituted weighting function encorporating the frequency characteristics of the measuring system corresponds with the normal weighting function up to an error of 0.01% to 1%, if the crosswise frequency of the individual measurement section corresponds to the crosswise frequency of the whole system at about 10^3. If this correlation is less than 10^2, the measurement error is larger. Signals have to go through bandpass filters to eliminate random frequencies and to obtain cross correlation functions for evaluation by analog computation. This mathematical model makes it possible to determine two differing time constants, the ranking number, and static amplification of a linear system. Transl. by G.G.

N68-15041# Technische Hogeschool, Eindhoven (Netherlands).
OPTIMIZATION OF SAMPLED-DATA CONTROL SYSTEMS USING DYNAMIC CRITERIA [OPTIMALISATIE VAN INTERMITTERENDE REGELSYSTEMEN MET BEHULP VAN DYNAMISCHE CRITERIA]
Alfred Leo Nagel (Ph.D. Thesis) 1967 187 p refs In DUTCH; ENGLISH summary

Presented is a study of optimal sampling control for processes which can be described by one dead time and two time constants. The types of controllers used are sampling modifications with proportional, integrating, and differentiating actions. The experimental method and some possibilities for computing and optimizing the criterion integrals are discussed, especially methods of analog simulation and integral evaluation on the IBM 1620 using a Fortran program. It is shown in what way the optimal settings and criterion values depend on the time constants, the dead time, and the sampling time. A mathematical analysis of the results is given starting from the characteristic equation of the system, the degree of which increases with increasing ratio of dead time to sampling time. K.W.

N68-15091# Rutgers Univ., New Brunswick, N. J. Statistics Center.
SUPPLEMENT TO TABLES OF JOINT PROBABILITIES
E. G. Schilling and H. F. Dodge Jun. 1967 26 p ref
(Contract Nonr-404(18))
(TR-N-29; AD-654179)

The report supplements AD-654 178. It provides additional tables of the joint probability of a sample mean greater than some limit A and exactly i defectives in a sample of n1 for samples taken from a standard normal distribution. Values are presented for i = 0 with samples sizes 11 to 20 and population fraction defective p = .005, .01, .02, .05, .10, .15, .20. Author (TAB)

N68-15092# Wisconsin Univ., Madison. Mathematics Research Center.
ORTHOGONALLY SCATTERED MEASURES
P. Masani Aug. 1967 93 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-738; AD-662742)

The report gives a coherent account of countably additive orthogonally scattered measures with values in a Hilbert space, and of the integration of complex-valued functions with respect to such

measures. Some lacunae in the theory are cleared up. It is shown how the use of the concept of a basic orthogonally scattered measure in problems amenable to Hilbert space methods yields a unified treatment of the continuous and discrete aspects of such problems. The Fourier-Plancherel transformation over locally compact abelian groups is treated from this standpoint, and its bearing on the continuous eigenfunction expansions encountered in scattering theory is indicated. Author (TAB)

N68-15093# Wisconsin Univ., Madison. Mathematics Research Center.
NEW ROOT-LOCATION THEOREMS FOR PARTITIONED MATRICES
J. L. Brenner Aug. 1967 19 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-748; AD-662744)

In solving systems of linear equations by iteration methods, an advance guarantee is sometimes needed that the iteration will converge. Such a guarantee is available from one or another of the class of theorems known as root-location theorems, or Gersgorin-type theorems. In an unpublished report, the author had given methods for discovering such theorems, and for finding counterexamples to unfounded conjectures. In the present paper, several new root-location theorems are given. TAB

N68-15112# George Washington Univ., Washington, D. C. Logistics Research Project.
PROGRAMMING NETWORK FLOWS PARAMETRICALLY VIA STRING ANALOGUE
Fred D. Rigby 11 Dec. 1967 30 p
(Contract N00014-67-A-0214)
(T-201; AD-663095)

The equilibrium properties of a conceptual mechanical system of strings and weights forming a network are examined and exploited to yield an algorithm for the solution of the standard problems of programming static network flows and several variants of those problems. The employment of an analogue network assures that the peculiar combinatorial aspects of these problems are put to work. The variant problems involve simultaneous flows, exploitation of constrictions of the network, and adjustment (variation) of capacities and cost. The latter are treated as parameters, with the consequence that the method can be categorized as a specialized form of parametric linear programming. Author (TAB)

N68-15125# RAND Corp., Santa Monica, Calif.
MAXIMAL SEPARATION THEOREMS FOR CONVEX SETS
Victor Klee Nov. 1967 39 p refs
(Contract F44620-67-C-0045; Grant NSF GP-3579; Proj. RAND)
(RM-5354-PR; AD-662331)

Most previous applications of separation theorems for convex sets have depended on rather crude separation results. Recent developments, however, indicate a need for more refined theorems, particularly for ones involving stronger types of separation. The stronger types of separation considered in this study include nice, open, closed, strict, and strong. The attempt to obtain separation theorems under minimal hypotheses suggests a search for maximal theorems, since each such theorem is, in a sense, a best possible result. Eighteen maximal theorems for disjoint nonempty convex subsets are derived, involving open, nice, strong and strict separation. Author (TAB)

N68-15150# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
THE FOURIER TRANSFORM FOR ABSTRACT SET FUNCTIONS
V. B. Korotkov and Yu. I. Gil'derman 22 Sep. 1967 21 p refs Transl. into ENGLISH from Sibirskiy Mat. Zh. (Moscow), v. 5, no. 4, 1964 p 844–852
(Contract NOw-62-0604-c)
(TG-230-T529; AD-663072)

By means of a correspondence (established in their previous paper (Gilderman and Korotkov, Sibirsk. Mat. Zh. No. 4 (1963), pp. 1426-1430)) between the spaces of abstracts set functions phi sub p (X, Omega) and the spaces of linear operators (L sub p(Omega) approaches X), the authors construct Fourier transforms for abstract set functions from phi sub p, $1 = or < p = or < 2$. Thus, fundamental theorems concerning Fourier transforms of numerical functions are generalized for Fourier transforms of abstract set functions. TAB

N68-15157# California Univ., Berkeley. Mathematics Dept.
STOCHASTIC ORDINARY DIFFERENTIAL EQUATIONS
John L. Strand Oct. 1967 110 p refs
(Contract Nonr-222(88))
(AD-662034)

If some of the driving forces or coefficients which occur in the differential equation are replaced by random functions (i.e. stochastic processes) one has a random differential equation. Basic existence theorems are established for these based on the different interpretations which may then be attached to the notion of derivative, assumptions on the equations, and types of solutions. A new class of generalized stochastic function is introduced. TAB

N68-15160# Wisconsin Univ., Madison. Mathematics Research Center.
CHARACTERIZATIONS OF C*-ALGEBRAS
Theodore W. Palmer Jul. 1967 6 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-775; AD-662734)

A Banach algebra is a C*-algebra iff each element can be expressed as R + iJ where R and J have real numerical range. A Banach algebra with an involution is a C*-algebra iff the closed convex hull of (e to the power (iR): R = R*) is the closed unit ball. Author (TAB)

N68-15162# National Bureau of Standards, Washington, D. C.
EXPERIMENTS IN THE COMPUTATION OF CONFORMAL MAPS
John Todd, ed. 20 Jan. 1966 33 p refs *Its* Appl. Math. Ser. 42
(PB-175819)

Descriptions are given of experiments in the general field of conformal mapping carried out by desk calculator, punched card equipment, and computer. Among the topics covered are the following: conformal mapping of a special ellipse on the unit circle; conformal mapping of the unit circle into an ellipse; theory and experiments of the solution of the Lichtenstein–Gershgorin integral equation; and numerical methods and harmonic measure computation. N.E.N.

N68-15236# California Univ., Berkeley. Dept. of Mathematics.
APPLICATION OF PERIODIC SURFACES TO A SPECIAL CLASS OF PROBLEMS

Stephen P. Diliberto Oct. 1967 17 p *ref*
(Contract Nonr-222(88))
(AD-662231)

It is shown that the special class of problems considered here can be transformed by various devices (depending on the particular equation) to the standard form normally employed in existence theorems for periodic surfaces. Author (TAB)

N68-15277 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE HARNACH INEQUALITY FOR SOLUTIONS OF ELLIPTIC DIFFERENTIAL EQUATIONS OF THE SECOND ORDER [O NERAVENSTVE KHARNAKA DLYA RESHENIY ELLIPTICHESKIKH DIFFERENTSIAL'NYKH URAVNENIY VTOROGO PORYADKA]
S. N. Kruzhkov and L. P. Kuptsov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 3–14 refs (See N68-15276 06-10)

Theorems on an inequality of the Harnach type and on a generalization of this inequality are extended to solutions of second order elliptic differential equations. Assumptions concerning the coefficients are outlined, the existence of various integrals is shown, and the two theorems used in the solutions are proved. C.T.C.

N68-15278 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE UNIQUENESS OF THE EXPANSION IN A TRIGONOMETRIC SERIES FOR METHODS OF SUMMATION [O YEDINSTVENNOSTI RAZLOZHENIYA V TRIGONOMETRICHESKIY RYAD DLYA METODOV SUMMIROVANIYA]
M. I. Livshits *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 15–26 refs (See N68-15276 06-10)

The principal theorem of this paper states the following: Let a trigonometric series with coefficients tending to zero be summable by the Toeplitz method almost everywhere in the interval $[-\pi, \pi]$ to an integrable function f(x) and let its partial sums be bounded at each point except possibly for a denumerable set of points. This series is then the Fourier series of the function f(x). Author

N68-15279 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON A UNIQUENESS THEOREM IN THE THEORY OF HYPERBOLIC QUASI-LINEAR EQUATIONS [OB ODNOY TEOREME YEDINSTVENNOSTI V TEORII GIPERBOLICHESKIKH KVAZILINEYNYKH URAVNENIY]
N. N. Kuznetsov and Chung-tao Chi *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 27–34 refs (See N68-15276 06-10)

The Cauchy problem for a hyperbolic system of quasilinear equations is studied in the half-plane $t \geq 0$. Generalized solutions are obtained as functions satisfying integral relations by applying Green's formulas. C.T.C.

N68-15280 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT DIRECT POWERS OF UNARY ALGEBRAS [O PRYAMYKH STEPENYAKH UNARNYKH ALGEBR]
O. A. Ivanova *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 35–43 ref (See N68-15276 06-10)

This paper is conberned with the question as to whether the isomorphism of unary algebras follows from the isomorphism of their nth powers. An affirmative answer is obtained for the finite class and some classes of infinite unary algebras. Author

N68-15294# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON A PRIORI ESTIMATE FOR SOME QUASI-LINEAR PARABOLIC SYSTEMS
T. D. Venttsel 23 Oct. 1967 5 p Transl. into ENGLISH from Vestn. Mosk. Univ., Ser. I: Mat. i Mekhan. (Moscow), no. 3, 1967 p 27–31
(Contract NOw-62-0604-c)
(TG-230-T532; AD-663075)

Considered is the boundary-value problem for systems of the form A (the second partial derivative of u with respect to x) = (the partial derivative of u with respect to t) + the partial with respect to x of the quantity (grad phi (u)), u = (u sub 1 ..., u sub n), where A is a constant, positive-definite, symmetric matrix. The function phi (u) is assumed to have an exponential order of increase: phi (u) = O (the absolute value of u) superscript (p + 2). An a priori estimate for max (absolute value of u) is established for $p < 3/2$. The estimate is derived by comparing energy estimates obtainable for solutions of the problem being considered. It follows from the derived solution that a solution to the problem exists in the large. TAB

N68-15321# Wisconsin Univ., Madison. Mathematics Research Center.
ON THE UNIQUENESS OF SOLUTIONS OF QUADRATIC EQUATIONS
L. B. Rall Jul. 1967 9 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-802; AD-662729)

Sufficient conditions for global and local uniqueness of solutions of quadratic equations in linear spaces are given. An example of a quadratic ordinary differential equation with a unique solution is presented. Author (TAB)

N68-15324# Wisconsin Univ., Madison. Mathematics Research Center.
APPROXIMATE SOLUTION OF INITIAL-BOUNDARY PARABOLIC PROBLEMS BY BOUNDARY VALUE TECHNIQUES
Donald Greenspan Aug. 1967 19 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-782; AD-662740)

A simple, fast numerical boundary value technique is developed for classes of initial-boundary value problems for mildly nonlinear parabolic equations. The method is based on finite difference methods, avoids stability problems, and is applied to several interesting equations, including a nonhomogeneous Burgers equation. Author (TAB)

N68-15325# Wisconsin Univ., Madison. Mathematics Research Center.
UNBOUNDED NORMAL OPERATORS ON BANACH SPACES
Theodore W. Palmer Sep. 1967 57 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-788; AD-662707)

The theory of unbounded maximal normal operators on Hilbert space, developed by von Neumann and Stone, is generalized to complex Banach spaces. Although defined by algebraic properties,

the normal operators introduced here are closely related to the unbounded spectral operators of scalar type introduced by Bade and to a generalization of those operators defined here. Author (TAB)

N68-15426# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOSCOW. UNIVERSITY. HERALD. SERIES 1. MATHEMATICS, MECHANICS (COLLECTION OF ARTICLES)
27 Apr. 1967 93 p refs Transl. into ENGLISH of the Publ. "Vestnik Moskovskogo Universiteta. Nauchnyy Zhurnal Devyatnadtsatyy God Izdaniya. Seriya 1. Matematika, Mekhanika Vykhodit Odin Raz V Dva Mesyatsa" Moscow, Izd. Mosk. Univ., 1964 p 1–74
(FTD-MT-64-560; AD-662584)

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2. THE STABILITY OF A ZERO SOLUTION OF A SYSTEM OF LINEAR EQUATIONS DURING CONSTANT PERTURBATIONS L. V. Khokhlova p 9–19 refs (See N68-15428 06-19)

3. DU BOIS-REYMOND THEOREM FOR GENERALIZED INTEGRALS AND TRIGONOMETRIC SERIES SUMMABLE BY THE ABEL-POISSON METHOD V. A. Skvortsov p 21–26 refs (See N68-15429 06-19)

4. ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF CERTAIN CLASSES OF DIFFERENTIAL EQUATIONS WITH SMALL PARAMETER WITH THE HIGHEST DERIVATIVE A. B. Yasil'yeva and A. B. Zimin p 27–37 refs (See N68-15430 06-19)

5. GROUP CONNECTIONS OF ABSOLUTE PARALLELISM REALIZABLE ON THE HYPERSURFACES OF AN AFFINE SPACE A. K. Rybnikov p 39–52 refs (See N68-15431 06-19)

6. DISTRIBUTION OF PRESSURE ON SURFACE OF ELLIPSOIDS A. I. Shvets p 55–61 refs (See N68-15432 06-32)

7. THEORY OF PLASTICITY OF ANISOTROPIC MEDIA V. A. Lomakin p 63–69 refs (See N68-15433 06-32)

8. APPLICATION OF ANALOG COMPUTERS FOR ITERATIVE PROCESS OF DETERMINING CONTROL IN ONE OPTIMAL SYSTEM V. V. Aleksandrov p 71–76 refs (See N68-15434 06-10)

9. STABILITY OF DISSIPATIVE SYSTEMS S. Ya. Stepanov p 77–86 refs (See N68-15435 06-23)

10. AN APPROXIMATE CALCULATION OF NONHOMOGENEOUS PLATES BY SUBDIVISION INTO ELEMENTS V. P. Kandidov p 87–95 refs (See N68-15436 06-32)

N68-15427# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
UNIQUENESS OF GENERALIZED SOLUTION OF THE CAUCHY PROBLEM FOR HYPERBOLIC SYSTEM OF TWO QUASI-LINEAR EQUATIONS [OB YEDINSTVENNOSTI OBOBSHCHENNOGO RESHENIYA ZADACHI KOSHI DLYA GIPERBOLICHESKOY SISTEMY DVUKH KVAZILINEYNYKH URAVNENIY]
N. N. Kuznetsov and Chung-tao Chi *In its* Moscow. Univ. Herald Ser. 1. Math., Mech. 27 Apr. 1967 p 3–8 refs (See N68-15426 06-19)

The uniqueness theorem is generalized, and it is assumed that the solutions to the formulated problem have, in addition to discontinuity lines, some special singularities termed centered rarefaction waves. The treatment is confined to the case when the system under consideration consists of only two equations. Author

N68-15428# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE STABILITY OF A ZERO SOLUTION OF A SYSTEM OF LINEAR EQUATIONS DURING CONSTANT PERTURBATIONS [OB USTOYCHIVOSTI NULEVOGO RESHENIYA SISTEMY LINEYNYKH URAVNENIY PRI POSTOYANNO DEYSTVUYUSHCHIKH VOSMUSHCHENIYAKH]
L. V. Khokhlova *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech., 27 Apr. 1967 p 9–19 refs Presented at Lomonosov Moscow State Univ. Seminar on Appl. Qualitative Theory of Differential Equations, Moscow, 27 Mar.–3 Apr. 1963 (See N68-15426 06-19)

A system of linear differential equations with variable coefficients is considered. An admissible set of perturbations is determined for which the zero solution is stable. Two original criteria of stability, that are of interest for applications, and several effective estimates are presented. Some examples are given. Author

N68-15429# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DU BOIS-REYMOND THEOREM FOR GENERALIZED INTEGRALS AND TRIGONOMETRIC SERIES SUMMABLE BY THE ABEL-POISSON METHOD [TEOREMA DYU-BUA-REYMONA DLYA OBOBSHCHENNYKH INTEGRALOV TRIGONOMETRICHESKIKH RYADOV SUMMIRUYEMYKH METODOM ABELYA-PUASSONA]
V. A. Skvortsov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 21–26 refs (See N68-15426 06-19)

The principal theorem is the following: There exists a trigonometric series which is A-summable for each x to a finite and D-integrable function f(x) but is not the Denjoy–Fourier series for f(x). Author

N68-15430# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC BEHAVIOR OF SOLUTIONS OF CERTAIN CLASSES OF DIFFERENTIAL EQUATIONS WITH SMALL PARAMETER WITH THE HIGHEST DERIVATIVE [ASIMPTOTIKA RESHENIY NEKOTORYKH KLASSOV DIFFERENTSIAL'NYKH URAVNENIY S MALYM PARAMETROM PRI STARSHEY PROIZVODNOY]
A. B. Yasil'yeva and A. B. Zimin *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 27–37 refs (See N68-15426 06-19)

Consideration is given to the problem of constructing the solution of differential equations with a small parameter at the highest derivative, when the root of the degenerate equation $F(z,t)=0$ is odd-multiple. The stability condition for the first approximation is no longer valid. The asymptotic distribution $z(t,\mu)$ is plotted; outside the boundary layer this takes the form of fractional powers series for the parameter μ. Theorems are given for obtaining the zero approximation outside the boundary layer, the zero-order approximation uniform over the whole interval of variation in t; and the asymptotic distribution of arbitrary degree of accuracy outside the boundary layer. M.G.J.

N68-15431# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
GROUP CONNECTIONS OF ABSOLUTE PARALLELISM REALIZABLE ON THE HYPERSURFACES OF AN AFFINE SPACE [O GRUPPOVYKH SVYAZNOSTYAKH ABSOLYUTNOGO PARALLELIYMA, REALIYUYEMYKH NA GIPERPOVERKHNOSTYAKH AFFINNOGO PROSTRANSTVA]

A. K. Rybnikov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 39–52 refs (See N68-15426 06-19)

Consideration is given to the problem of obtaining the necessary and sufficient conditions which have to be satisfied by the n-dimensional (n>2) spaces of group connections of absolute parallelism of the first class, i.e., is realizable on hypersurfaces of affine space. Author

N68-15492# North Carolina Univ., Chapel Hill. Dept. of Statistics.
SOME RESULTS USING GENERAL MOMENT FUNCTIONS
Walter Laws Smith Nov. 1967 22 p refs *Its* Inst. of Statist. Mimeo Series No. 554
(Grant Nonr-855(09))
(AD-662238)

The paper proves a theorem which, in a somewhat more restricted version, was given by the author during the Chapel Hill Symposium on Congestion Theory (Smith and Wilkinson (1965), pp 132-133). The proof then available was needlessly complicated; it now follows from a useful general theorem concerning generating functions. TAB

N68-15496# California Univ., Berkeley. Mathematics Dept.
A GENERALIZATION OF GRONWALL'S LEMMA TO HIGHER DIMENSIONS
Stephen P. Diliberto Oct. 1967 9 p
(Contract Nonr-222(88))
(AD-662232)

Gronwalls lemma classically provides the exponential type estimate used to establish uniqueness and continuity properties of solutions of ordinary differential equations. For random ordinary differential equations a new type of estimating technique is needed. This is provided here. TAB

N68-15517# California Univ., Berkeley. Operations Research Center.
TESTS FOR MONOTONE FAILURE RATE BASED ON NORMALIZED SPACINGS
Peter J. Bickel and Kjell A. Doksum Sep. 1967 44 p refs
(Contracts Nonr-3656(18); Nonr-222(83); N00014-67-A-0114-0004)
(ORC-67-37; AD-661828)

Let x sub (1) < . . . < x sub (n) be the order statistics of a random sample from a population with density F and distribution function F such that F(0) = 0. Let Q(T) = F(T/(1 − F(T)) be the failure rate of F. In testing H sub O: Q(T) = lambda vs. H sub L: Q(T) vertical arrow, Proschan and Pyke (Vth Berk. Symp.) considered certain statistics based on R sub L, . . . , R sub N, the ranks of the normalized sample spacings D sub I = (N − I + L) (X sub (I) − X sub (I − L)), 1 = or < I = or < N, X sub (O) = 0. They show that these statistics are asymptotically normal for fixed F and compute the efficacy of one of these statistics for selected distributions. This report shows that asymptotic normality holds also for sequences of alternatives approaching H sub O as N approaches infinity and conclude that the above efficacies yield Pitman efficiencies. TAB

N68-15527# Wisconsin Univ., Madison. Mathematics Research Center.
RESONANCE IN ALMOST LINEAR SYSTEMS
H. C. Levey and J. J. Mahony Aug. 1967 29 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-769; AD-662739)

Estimates, useful for all times, are sought for the resonant response of a system with small non-linearity. It is shown that the method of multiple scales can be used to generate a representation which is formally asymptotic at all times and over a significant time interval is a valid approximation to some solution of the system. It is shown, by example that this estimate is not always a useful representation of any one solution for all time. Plausible arguments are given that the approximation is nevertheless useful for the determination of the behavior of a physical system if not of the pathological solutions of the differential equations which may represent it. Author (TAB)

N68-15528# Wisconsin Univ., Madison. Mathematics Research Center.
SPECTRAL PROPERTIES OF COLLECTIVELY COMPACT SETS OF LINEAR OPERATORS
P. M. Anselone and T. W. Palmer Aug. 1967 13 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-767; AD-662731)

A number of spectral properties of individual compact linear operators are generalized to collectively compact sets of linear operators. These results are used to prove that a set of normal operators on a complex uniformly smooth Banach space is collectively compact iff it is a totally bounded set of compact operators. Author (TAB)

N68-15531# Wisconsin Univ., Madison. Mathematics Research Center.
A DECOMPOSITION ALGORITHM FOR SHORTEST PATHS IN A NETWORK
T. C. Hu Sep. 1967 19 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-804; AD-662730)

Given a n-node network with lengths associated with arcs. The problem is to find the shortest paths between every pair of nodes in the network. If the network has less than n(n-1) arcs, then it is possible to treat parts of the network at a time and then get the shortest paths between every pair of nodes. This decomposition algorithm saves the amount of computation as well as the storage requirement of a computer. Author (TAB)

N68-15532# Wisconsin Univ., Madison. Mathematics Research Center.
BAYESIAN ANALYSIS OF BINOMIAL PARAMETERS
Norman Draper and Irwin Guttman Aug. 1967 19 p refs
(Contracts DA-31-124-ARO(D)-462; Nonr-1202(17))
(MRC-TSR-764; AD-662732)

A recurring experimental problem is the comparison of several binomial populations to see if their underlying parameter values theta sub 1 are equal. Here a Bayesian attack is made on this problem. Exact tests are possible but difficult, but an approximate procedure using the multinormal distribution may be employed. Some examples are provided. Author (TAB)

N68-15533# Wisconsin Univ., Madison. Mathematics Research Center.
A UNIQUENESS THEOREM FOR THE EQUATION (d + Vdl + k^2) u(x) = 0, AND THE REPRESENTATION OF THE POTENTIAL SCATTERING OPERATOR
G. Schmidt Aug. 1967 17 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-783; AD-662728)

In this paper a uniqueness theorem is proved for solutions of the equation (delta + V(x) + k sq.) u(x) = 0, satisfying a radiation condition and a boundary condition. With the aid of this theorem a new and very natural derivation is given for the integral representation of the Schrodinger potential scattering operator which was first rigorously obtained by Ikebe. Author (TAB)

N68-15536# Wisconsin Univ., Madison. Mathematics Research Center.
SEIDEL-EQUIVALENCE AND EMBEDDING OF STRONGLY REGULAR GRAPHS
S. S. Shrikhande Jul. 1967 26 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-779; AD-662733)

Necessary conditions for existence of partially balanced incomplete block designs with non-L sub 2(4) and non-T(8) association schemes are derived. These are based on the facts that the non-L sub 2(4) scheme is Seidel-equivalent to the L sub 2(4) scheme and the three non-T(8) schemes are Seidel-equivalent to the T(8). Necessary conditions for embedding of a strongly regular graph on v vertices in a strongly regular graph on v + 1 vertices are also obtained and some new association schemes are constructed. Author (TAB)

N68-15580 Joint Publications Research Service, Washington, D. C.
CONTROL PROBLEMS IN MATHEMATICAL ECONOMICS MODELS
G. S. Pospelov and A. A. Poduzov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 50–68 refs (See N68-15576 06-10)

Efforts are made to represent the control functions in economics in explicit form and to discover the characteristic features of the equations which describe the process of economic development. Linear and nonlinear dynamic economics models are investigated. It is shown how these models may be obtained from the model of augmented reproduction. When investigating nonlinear models the qualitative influence of the population growth and scientific and engineering progress on economics is traced. It is demonstrated that economics as the object of control is described by systems of ordinary differential equations (with a delay argument) with specific restrictions on the controls and on the phase coordinates. Author

N68-15584 Joint Publications Research Service, Washington, D. C.
SOME PROBLEMS IN QUEUEING THEORY
B. V. Gnedenko and I. N. Kovalenko *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 118–134 refs (See N68-15576 06-10)

A detailed survey of basic queueing problems is given as well as several approaches to mathematical problems of queueing. To develop general methods of queueing and also for the summation of random variables, the relationship between the two problems is considered in forming the controls. Especially the construction of digital computers and control devices requires queueing processes. G.G.

N68-15585 Joint Publications Research Service, Washington, D. C.
A CONTROLLED QUEUEING SYSTEM
O. I. Bronshteyn and Ye. B. Veklerov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 135–141 refs (See N68-15576 06-10)

This article contains an investigation of a single queue queueing system with waiting, N simplest input flows of requests and constant servicing times. A broad class of rules for selection of the requests for servicing is introduced including as extreme cases absolute and relative priorities. The average queues are calculated in the stationary condition with respect to each flow, and the order of servicing of the requests is found for which the economic losses connected with waiting of the requests in the system are minimal. Author

N68-15586 Joint Publications Research Service, Washington, D. C.
SERVICING TWO FLOWS IN A SINGLE QUEUE SYSTEM WITH A LIMITED NUMBER OF PLACES FOR WAITING AND ABSOLUTE PRIORITY
G. P. Basharin *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 142–156 refs (See N68-15576 06-10)

A single queue queueing system is analyzed to which two simplest flows of requests come with absolute priority. The servicing time for the requests in each flow has exponential distribution with different average values. The case of the general queue and the case of separate queues of limited length are investigated. Author

N68-15587 Joint Publications Research Service, Washington, D. C.
EVALUATING THE RELIABILITY OF OPERATION OF A HIERARCHICAL BRANCHED SYSTEM WITH NONEQUIVALENT ACTUATING ELEMENTS
I. A. Ushakov *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 157–163 ref (See N68-15576 06-10)

This article contains an investigation of the reliability of a hierarchical system with branched structure the actuating elements of which made a definite contribution to the general output effect of the system. The proposed method of evaluation is illustrated in an example of an automatic control system for the output of a gas condensate enterprise. Author

N68-15588 Joint Publications Research Service, Washington, D. C.
A PROCEDURE FOR PROBABILITY EVALUATION OF THE RELIABILITY OF HYPOTHESES IN COMPLEX DIAGNOSTIC PROBLEMS
Yu. M. Gorskiy and V. V. Novorussiky *In its* Tech. Cybernetics, No. 5, 1967 23 Jan. 1968 p 164–173 refs (See N68-15576 06-10)

The possibility of using the apparatus of the inverse functions of the algebra of logic and inverse finite automata for probability evaluation of the validity of hypotheses when solving complex diagnostic problems is investigated. Author

N68-15602# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MINIMIZATION OF SMOOTH CONVEX FUNCTIONAL ON A CONVEX SET [MINIMIZATSIYA GLADKOGO VYPUKLOGO FUNKTSIONALA NA VYPUKLOM MNOZHESTVE]
V. F. Dem'yanov and A. M. Rubinov *In its* Leningrad. Univ. Learld. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 3–19 refs (See N68-15601 06-23)

A Banach space X on which a convex functional f with gradient F is given, is considered. It is assumed that F has

derivative F'. Successive approximations are constructed to avoid certain infinite procedures, and it is proved that this also yields the desired minimum in the limit. The proof is then specialized to the case of a linear set. The theory is applied to optimization problems in automatic control and problems in approximation theory and integer programming. L.S.

N68-15603# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NECESSARY CONDITIONS OF STRONG STABILITY OF HAMILTON EQUATIONS WITH UNLIMITED PERIODIC OPERATIONAL COEFFICIENTS [NEOBKHODIMYYE USLOVIYA SIL'NOY USTOYCHIVOSTI GAMIL'TONOVYKH URAVNENIY S NEOGRANICHENNYMI PERIODICHESKIMI OPERATORNYMI KOEFFITSIYENTAMI]
V. I. Derguzov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 21–38 refs (See N68-15601 06-23)

The linear Hamilton equations with periodic operator coefficients in Hilbert space W $J/dx/dt = H(t)x$, $H(t+T) = H(t)$ are considered. The antisymmetric operators J u J^{-1} are supposed to be bounded. Generally speaking, H(t) is a self-adjoint unbounded operator. The well-known (for finite dimensions W) necessary conditions of the theorem of Krein–Gelfand–Lidsky about strong stability in the terms of the spectrum of monodromy operator are carried over on the equations of this type. Author

N68-15606# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LATTICE EXPANSIONS OF INFINITELY DIVISIBLE LAWS [O RAZLOZHENIYAKH RESHETCHATYKH BEZGRANICHNO DELIMYKH ZAKONOV]
I. V. Ostrovskiy *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 65–79 refs (See N68-15601 06-23)

A characteristic function with certain satisfied conditions outlined is used in a theorem proof for the lattice expansions of infinitely divisible lattices. L.S.

N68-15608# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NORMS OF LINEAR POLYNOMIAL OPERATORS IN CONNECTION WITH PROBLEMS OF APPROXIMATION OF CONTINUOUS FUNCTIONS [O NORMAKH LINEYNYKH AMI PRIBLIYHENIYA NEPRERYVNYKH FUNKTSII]
N. A. Sapogov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Apr. 1967 p 97–102 refs (See N68-15601 06-23)

Results obtained in problems involving approximation of certain continuous functions are extended to the case of operators whose values are linear combinations of functions of Sturm–Liouville (SL) polynomials. The SL problem is stated by means of differential equations, and boundary conditions are outlined. L.S.

N68-15609# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE PROPERTY OF A MEASURABLE FUNCTION [OB ODNOM SVOYSTVE IZMERIMOY FUNKTSII]
G. Ya. Yarakhmedov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 103–112 refs (See N68-15601 06-23)

The behavior of the difference of a measurable function is considered in the framework of Boolean algebra. It is assumed that E and F are two numerical sets, belonging to segment (a,b) with set E preceding set F. Theorem proofs outlining the properties of the measurable function are presented. L.S.

N68-15622# California Univ., Berkeley. Dept. of Mathematics.
CONTRIBUTIONS TO THE MATHEMATICAL THEORY OF EVOLUTIONARY ALGORITHMS
J. A. Goguen and N. H. Goguen Sep. 1967 36 p refs
(Contract Nonr-3656(08); Nonr-222(85))
(AD-662237)

Evolutionary algorithms can be, and have been, applied to a wide variety of practical problems. Those interested in such applications may also be interested in the relevant mathematical theory, in the hope that it will illuminate questions of relative effectiveness. This report develops some general theory of abstract evolutionary algorithms, including determination of the expected number of steps, the asymptotic distribution of the reduction factor, and a brief discussion of stop rules. It also describes a computer program model of an evolutionary algorithm which uses uniformly distributed random direction; this seems to help avoid certain traps which plagued earlier algorithms. Also reported are the results of experiments with this algorithm which were designed to check the theoretical predictions. Finally, there are some comments on possible biological interpretations. Author (TAB)

N68-15631# California Univ., Berkeley. Dept. of Mathematics.
SCALE FACTORS FOR PERIODIC SURFACES
Stephen P. Diliberto Oct. 1967 6 p *ref*
(Contract Nonr-222(88))
(AD-662233)

It is shown that scalar change in velocity for a flow leaves the formula for periodic surfaces unchanged. This fact is used to establish an existence theorem for periodic surfaces. Author (TAB)

N68-15654# RAND Corp., Santa Monica, Calif.
THE OUT-OF-KILTER ALGORITHM: A PRIMER
E. P. Durbin and D. M. Kroenke Dec. 1967 29 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5472-PR; AD-663370)

The Memorandum describes the operation and capability of the Out-of-Kilter algorithm under the assumption that the reader is conversant with basic linear programming. It should be useful to analysts and planners interested in a versatile modeling concept and computational tool. TAB

N68-15719# RAND Corp., Santa Monica, Calif.
A REPRESENTATION FOR THE SOLUTION OF FREDHOLM INTEGRAL EQUATIONS
H. H. Kagiwada, R. E. Kalaba, and A. Schumitzky Nov. 1967 10 p refs
(Contract F44620-67-C-0045; Proj. RAND)
(RM-5515-PR; AD-662332)

The report gives a new representation formula for the solution of Fredholm integral equations of the second kind. The formula has certain computational advantages over the usual representation involving the resolvent or the representation formula of Krein. It makes use of the phi function and requires two integrations. The usual method of solution uses either the Fredholm resolvent (three variables) or the Krein representation, which requires differentiation as well as integration. The Bellman-Krein partial differential equation for the resolvent can also be obtained using this new formula. TAB

N68-15728# California Univ., Berkeley.
COMPLEX: A COMPLEMENTARY SLACKNESS, OUT-OF-KILTER ALGORITHM FOR LINEAR PROGRAMMING
William S. Jewell Mar. 1967 96 p refs
(Contracts Nonr-222(83); DA-31-124-ARO(D)-331; Grant NSF GP-7417)
(ORC-67-6; AD-662668)

An algorithm has been developed which uses the complementary slackness principle to take completely arbitrary primal and dual solutions to a linear program with doubly-bounded variables into the optimal solutions. The algorithm is not a new method; viewed in the proper context, it can be thought of either as an elaboration of the primal-dual, composite, breakpoint-tracing, or complementary pivot algorithms; as an extension of the out-of-kilter or black-box methods for network flows; or, finally, even as a special way of looking at the original simplex algorithm. Almost all of the simpler procedures, such as Phase I, the dual simplex method, parametric programming, the primal-dual algorithm, etc. can be viewed as special cases of the complex algorithm which use special starting solutions and special heuristics. TAB

N68-15736# Northwestern Univ., Evanston, Ill. Information-Processing and Control Systems Lab.
SPACE FILLING CURVES AND MATHEMATICAL PROGRAMMING
A. R. Butz Nov. 1967 35 p refs
(Contract N00014-67-A-0356-0003; Grant NSF GK-1540)
(TR-67-115; AD-663170)

The problem of finding x bar in n dimensional Euclidean space such that f sub i (x bar), = or < 0, 1 = 1, 2,..., N, is considered. The only assumption on the f sub i is that a solution exists in the quantized unit hypercube. TAB

N68-15772# RAND Corp., Santa Monica, Calif.
NOTES ON SUMS OF SQUARES OF CONSECUTIVE ODD INTEGERS
William Sollfrey Dec. 1967 8 p refs
(P-3744; AD-662591)

In the latest of a series of papers, Brother U. Alfred has investigated the conditions under which the sum of the squares of N consecutive odd integers can be a square. He derives several theorems to eliminate many values of N, and finds solutions for other values. Eight numbers below 1000 (193, 564, 577, 601, 673, 724, 772, 913) remain unresolved. Also, in his table of solutions there are 17 values for which the solution exceeds 10 digits, and one contains 34 digits. In this note the eight cases will be resolved, and solutions will be presented for the 17 cases, only one of which contains as many as 7 digits. A systematic procedure for finding these solutions will be demonstrated. TAB

N68-15819# Wisconsin Univ., Madison. Mathematics Research Center.
AN APPLICATION OF AN ESTIMATE OF THE RIEMANN MAPPING FUNCTION FOR CERTAIN STAR SHAPED DOMAINS
John R. Cannon (Minnesota Univ., Minneapolis) Sep. 1967 10 p refs
(Contract DA-31-124-ARO(D)-462; Grant NSF G-6052)
(MRC-TSR-787; AD-662741)

Let D denote a simply connected domain contained in the simply connected star-shaped domain G. Let u denote a harmonic function in G which is bounded by M throughout G and by m , m < M, in D. For any compact set S in G, there exist explicitly defined constants K = K(M,G,D,S) and alpha = alpha(G,D,S), 0 < alpha < 1, such that the absolute value of u < K(m to the power alpha) throughout S. Author (TAB)

N68-16027 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STRICT ESTIMATE OF ERROR OF INTEGRATION OF DIFFERENTIAL EQUATIONS BY THE STOERMER METHOD [STROGAYA OTSENKA POGRESHNOSTI INTEGIROVANIYA DIFFERENTSIAL'NYKH URAVNENIY METODOM SHTERMERA]
L. Ya. Adrianova *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 3–17 refs (See N68-16026 06-23)

Instructions are given for using Stoermer's method in rigorous a priori error estimation of the numerical integration of a system of second order differential equations. A table of quantities necessary for estimating the error are presented. These quantities are dependent only on the order of the Stoermer method and are independent of the right side of the equation being integrated. A numerical example is included. E.J.S.

N68-16028 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE CRITERION OF STABILITY OF HILL'S EQUATION [OB ODNOM KRITERII USTOYCHIVOSTI URAVNENIYA KHILLA]
B. N. Kozinets *In its* Leningrad. Uriv. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 19–26 ref (See N68-16026 06-23)

A differential equation is developed to show that the set of points of stability is an open set, and consequently, decomposes into not more than a denumerable number of connected regions. A theorem is then formulated for separating these regions into an explicit form. E.J.S.

N68-16029 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ASYMPTOTIC DISTRIBUTION OF THIRD ORDER INTEGRAL MATRICES (ON THE 75TH BIRTHDAY OF PROF. L. YA. MORDELL) [ASIMPOTICHESKOYE RASPREDELENIYE TSELOCHISLENNYKH MATRITS TRET'YEGO PORYADAKA]
Yu. V. Linnik and B. F. Skubenko *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 27–40 refs (See N68-16026 06-23)

A theorem on the asymptotic distribution of the integer 3×3 matrices X of a given determinant N, on the surface det (X) = N is proved. The theorem is useful in the asymptotic ergodic theory of integer matrices. Author

N68-16030 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AN APPROXIMATE METHOD OF SOLUTION OF DIRICHLET PROBLEM, AND ESTIMATES OF THE RATE OF CONVERGENCE OF SOLUTIONS OF DIFFERENCE EQUATIONS TO SOLUTIONS OF ELLIPTIC EQUATIONS WITH DISCONTINUOUS COEFFICIENTS [PRIBLIZHENNY METOD RESHENIYA ZADACHI DIRIKHLE I OB OTSENKAKH SKOROSTI SKHODIMOSTI RESHENIY RAZNOSTNYKH URAVNENIY K RESHENIYAM ELLIPTICHESKIKH URAVNENIY S RAZRYVNYMI KOEFFITSIENTAMI]
V. Ya. Rivkind *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 41–58 refs (See N68-16026 06-23)

A numerical method is given for solution of the Dirichlet problem for elliptical equations of the second order in arbitrary

two-dimensional domain. The domain is completed to a rectangle, and in the latter an elliptical equation with discontinuous coefficients is considered. The estimate for the variation of the original solution from the solution in the rectangle is found. The rate of convergence of the difference equations for elliptical equations with discontinuous coefficients is estimated. Author

N68-16031 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NORMS OF LINEAR POLYNOMIAL OPERATORS IN CONNECTION WITH PROBLEMS OF APPROXIMATION OF CONTINUOUS FUNCTIONS. I [O NORMAKH LINEYNYKH POLINOMIAL'NYKH OPERATOROV V SVYAZI S ZADACHAMI PRIBLIZHENIYA NEPRERYVNYKH FUNKTSIY. I]
N. A. Sapogov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 59–76 refs (See N68-16026 06-23)

Methods of proofs are generalized for theorems on the existence of continuous functions for which Fourier series and Lagrange interpolation processes do not coverge evenly. These proofs then make the theorems applicable to polynomial operators whose value can be differentiated from algebraic or trigonometric polynomials. E.J.S.

N68-16032 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN THEOREMS ABOUT PROBABILITY SEARCH IN A DETERMINED FIELD [NEKOTORYE TEOREMY O VEROYATNOSTNOM POISKE V DETERMINIROVANNOM POLE]
B. P. Kharlamov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 77–84 ref (See N68-16026 06-23)

Asymptotic properties of sequences of points in the affined metric Euclidean space are considered. The sequences are constructed according to the rule which determines the probability sampling of each next point depending on M=1 (m > > 0) directly preceding points and on m+1 real numbers corresponding to these points. The correspondence between the numbers and the points is defined by some constant (to time) nonrandom real-valued function. The rule of constructing such sequence is called "search." The boundedness conditions for the region of the most probable hit of the points of the sequence having sufficiently large indexes are formulated. Some sufficient conditions are given, under which the above are fulfilled. Author

N68-16041 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DIVIDING PARTITIONS FOR CERTAIN FAMILIES OF MEASURES [RAZDELYAYUSHCHIYE RAZBIYENIA DLYA NEKOTORYKH SEMEYSTV MER]
A. M. Kagan and V. N. Sudakov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 181–185 ref (See N68-16026 06-23)

Theorems are established for the cardinality of minimal partition of the abstract space X into disjointed subsets. These are divided into: the finite family of measures, the finite or enumerable family of continuous measures, and the family of rectangular distributions. Author

N68-16042 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FLAGTENSOR ALGEBRA [ALGEBRA FLAGTENZOROV]
R. I. Pimenov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 187–191 refs (See N68-16026 06-23)

A formalism generalizing the tensor algebra for flag space is constructed; it is called the flagtensor algebra. Three independent equivalent definitions of the flagtensor are given, and the application of the flagtensor algebra is illustrated by determining the set of invariants. Author

N68-16043 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ABSENCE OF A POSITIVE DISCRETE SPECTRUM FOR THE LAPLACIAN OPERATOR OF THE DIRICHLET PROBLEM IN CERTAIN UNBOUNDED REGIONS [OB OTSUTSTVII POLOZHITEL'NOGO DISKRETNOGO SPEKTRA U OPERATORA LAPLASA ZADACHI DIRIKHLE V NEKOTORYKH BESKONECHNYKH OBLASTYAKH]
A. G. Ramm *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 193–198 refs (See N68-16026 06-23)

It is found that under certain suppositions about the domain with the infinite bound the Laplace operator of the Dirichlet problem has no positive eigenvalues. Author

N68-16044 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ONE SIMPLE METHOD OF ESTABLISHING INDEPENDENCE OF STATISTICS [OBODNOM PROSTOM METODE USTANOVLENIYA NEZAVISIMOSTI]
T. S. Feygel'son *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 199–201 refs (See N68-16026 06-23)

Let P be a family of distribution of X. The statistic f(X) is named zonal, if its distribution is the same for all P ∈ P. It is proved that if a family of distribution of sufficient statistic T for P is complete, no zonal statistic depends on T. n-dimensional random variables are considered, and a zonal statistic independent of the system of sufficient statistics is constructed. Author

N68-16057# Wisconsin Univ., Madison. Mathematics Research Center.
UNIFORM APPROXIMATION BY TCHEBYCHEFFIAN SPLINE FUNCTIONS. 1: FIXED KNOTS
L. L. Schumaker Aug. 1967 33 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-768; AD-662709)

The best approximation (in the uniform norm) of a given continuous function by (Tchebycheffian) spline functions with fixed knots on an interval (a, b) is characterized in terms of an alternating property. The maximal alternator is studied, and uniqueness of the best approximation is precisely determined. Continuity of the best approximation and other related results are also obtained. Author (TAB)

N68-16094 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
AN INVERSION PROBLEM ASSOCIATED WITH COMPOSITIONS
G. Stell Dec. 1967 7 p refs
(Grant NSF GU-1557)
(TH/229)

The definition and solution is given for an inversion problem that is related to compositions as the product function-cluster function problem is related to partitions. A composition is considered an ordered collection of disjoint subsets, without regard to the order of the elements within a given subset, whose union is the whole set. The composition problem and its equations are considered; and integrals and their functional derivatives are used as purely algebraic objects of considerable notational convenience. Therefore, analytic questions of convergence and differentiability do not enter the discussion. M.W.R.

N68-16089# Queens Univ., Kingston (Ontario). Dept. of Mathematics.
SAMPLING THEOREM FOR THE FOURIER TRANSFORM OF A DISTRIBUTION WITH BOUNDED SUPPORT
L. L. Campbell Aug. 1967 22 p refs
(Contract DRB-713000; Grant A-2151)
(RR-67-1)

Functions which are Fourier transforms of distributions with support in the interval $(-\Omega, \Omega)$ are investigated; and it is shown that these more general bandlimited functions are still entire functions which are determined completely by the values at the points $n\pi/\Omega$. A series representation is given that is modified by an additional convergence factor, and a bound on the truncation error is obtained for this series. Further, it is shown that a sampling theorem in this modified form can be extended to a random process which has a bandlimited correlation function. The interpolation problem is examined by determining if there is a bandlimited function in a sequence of numbers. M.W.R.

N68-16106# California Univ., Davis Crocker Nuclear Lab.
VARIATIONAL CALCULATIONS WITH DENSITY MATRICES
Claude Garrod 1 Aug. 1967 5 p Presented at the Density Matrix Conf., Kingston, Canada
(Contract AT(11-1)-GEN-10)
(UCD-CNL-84; CONF-670828-3)

A brief review is given of the variational method developed by Percus and Garrod. Some applications of the method which are presently in progress are described. NSA

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N68-15017 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 79, NUMBER 8: DAILY AND AVERAGE SURFACE AND 850 MB MAPS OF THE NORTHERN HEMISPHERE, AUGUST 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 79, HEFT 8: TAEGLICHE UND MITTLERE BODEN UND 850 MB KARTEN DER NORDHEMISPHAERE IM JAHRE 1967, AUGUST]
Manfred Geb, Richard Scherhag et al 1967 84 p In GERMAN

In addition to a summary of the world weather situation for August 1967, this volume contains the following meteorological data for the same period: (1) charts of monthly mean meteorological data for the northern hemisphere; (2) daily 850-mb charts for the northern hemisphere; and (3) daily ground charts for the northern hemisphere. Transl. by K.W.

N68-15018 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 66, NUMBER 3: DAILY ALTITUDE MAPS OF THE 50 MB LAYERS ACCORDING TO MONTHLY MEAN MAPS, 1966 PART 3, THIRD QUARTER [METEOROLOGISCHE ABHANDLUNGEN. BAND 66, HEFT 3: TAEGLICHE HOEHENKARTEN DER 50 MB FLAECHE SOWIE MONATLICHE MITTELKARTEN FUER DAS JAHR 1966. TEIL 3, 3. VIERTELJAHR]
Regina Kirch, Barbara Kriester, Karin Labitzke, Richard Scherhag, and Renate Stuhrmann 1967 106 p In GERMAN

This volume contains the following meteorological data for the northern hemisphere for the period July 1 through September 30, 1966: (1) charts of the 50-mb level showing monthly means, derivations, and changes; (2) daily weather charts at the 50-mb level; and (3) a summary of the stratospheric circulation at the 50-mb level. Transl. by K.W.

N68-15028 Joint Publications Research Service, Washington, D. C.
METEOROLOGY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 6-33 refs Transl. into ENGLISH from Pravda (Moscow), 10 Dec. 1967 p 2 (See N68-15026 06-13)

Journalistic briefs and abstracted data are presented on weather forecasting; wind and temperature measurements; cloud cover, compositions, and seeding; precipitation measurements; atmospheric turbulence; and the activities of the hydrometeorological service. N.E.N.

N68-15032 Joint Publications Research Service, Washington, D. C.
MISCELLANEOUS
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 95-98 refs Transl. into ENGLISH from Russian (See N68-15026 06-13)

Hydrometeorological drifting stations attached to ice floes in the Arctic and Antarctic Oceans are briefly described. The drifting paths, working conditions on the vessels, and the airborne supplies to the stations are mentioned. N.E.N.

N68-15116# Stanford Research Inst., Menlo Park, Calif.
FORECASTING CLEAR-AIR TURBULENCE BY COMPUTER TECHNIQUES Final Report
Roy M. Endlich and Robert L. Mancuso Sep. 1967 93 p refs
(Contract FA66WA-1442)
(SRDS-RD-67-65)

Pilot reports of clear-air turbulence from four special five-day reporting periods are used to investigate relationships between turbulence probability and meteorological factors. The meteorological analyses are made by computer on a 2.5° latitude/longitude grid, on the basis of standard upper-air observations. Analyses are made for the United States for altitude layers 50 mb (approximately 4000 ft) thick. Temperature analyses interpreted as thermal wind shear are used to compensate for wind observations missing in high-speed portions of the flow. The best meteorological indicators

of turbulence are those related to the wind field. These indicators are vertical vector wind shear, deformation, and divergence. The analysis for turbulence is made from meteorological factors and pilot reports in terms of the probability of encountering significant turbulence (greater than light intensity) during flight segments 100 nautical miles long. Numerical forecasts of upper winds are prepared for the turbulence-reporting periods on the basis of advection and geostrophic departures. Author

N68-15172# National Weather Records Center, Asheville, N. C.
WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 2, PART 1. MIDDLE EAST
Oct. 1967 350 p
(AD-662425)

The volume is the second of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. Volume II, part 1 includes countries in the Middle East from Aden to India, in alphabetical order. TAB

N68-15227*# Allied Research Associates, Inc., Concord, Mass. Geophysics Div.
STUDIES OF TIROS AND NIMBUS RADIOMETRIC OBSERVATIONS Final Report
Earl S. Merritt, Paul E. Sherr, W. K. Widger, Jr., and Clinton J. Bowley Mar. 1967 110 p refs
(Contract NAS5-10151)
(NASA-CR-92544; Rept.-9630-F) CFSTI: HC $3.00/MF $0.65 CSCL 04B

Selected analyses of TIROS and Nimbus radiometric observations are presented. The TIROS-7 data were used to prepare a motion picture depicting the diurnal variation of the 8 to 12μ window radiation and, therefore, of average cloudiness over the island areas of Indonesia, Malaysia, and New Guinea. Certain aspects of Hurricane Alma (1966) were analyzed, using Nimbus-2 medium resolution infrared (MRIR) observations in addition to ESSA and Nimbus-2 photographic observations. High resolution infrared (HRIR) digitized data were analyzed for three cases: a Gulf of Alaska storm with cloud vortex, a frontal rain band over New England, and an anomalous bright band (daylight HRIR). M.G.J.

N68-15297# Deutscher Wetterdienst, Offenbach am Main (West Germany).
STATISTICAL CHARACTERISTICS OF THE UPPER WIND FOR THE NORTH ATLANTIC–EUROPEAN–NEAR EASTERN REGION [STATISTISCHE CHARAKTERISTIKEN DES HOEHENWINDES FUER DEN RAUM NORDATLANTIK–EUROPA–NAHER OSTEN]
Hans Guss 1967 46 p refs In GERMAN; ENGLISH summary
Its Vol. 105, No. 14

To meet the needs of German Civil aviation and to increase our knowledge of the circulation conditions of lower stratosphere in the North Atlantic–European–Near Eastern Region upper wind conditions at 225 mb and 96 mb have been examined. Radiowind measurements mainly were taken as a base. To obtain a network of points of intersection of coordinates these measurement results were completed from synoptic upper-air charts—for the above mentioned levels—in using cyclotrophic wind and by interpolation to a universe of wind values free of gaps. On the basis of such homogeneous material some statistical characteristics of upper wind have been computed and represented on regional maps for the North Atlantic–European Region with windroses, isotachs, mean vector wind, persistence as well as zonal and meridional standard deviation. In doing so the representativeness of the basic material was checked. Considerations based on the comparisons of these results yielded some essential features of the regional distribution of these upper wind parameters which appear interesting in relation to atmospheric circulation. Author

N68-15303 Finnish Meteorological Office, Helsinki.
CLIMATOLOGICAL DATA FROM JOKIOINEN AND SODANKYLAE OBSERVATORIES, 1966 [JOKIOISTEN JA SODANKYLAEN OBSERVATORIOIDEN ILMASTOHAVAINNOT 1966]
1967 50 p In FINNISH and ENGLISH

Results of observations made by the meteorological observatories of Jokioinen and Sodankyla in 1966 are presented. Values obtained from recordings are given for atmospheric pressure, temperature, relative humidity, wind direction and speed at even hours; also the amount of sunshine and clouds, including cloud formation and height; and hydrometeors observed with time of appearance, visibility and precipitations. Author

N68-15335 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 76, NUMBER 8: RESULTS OF THE RADIOSONDE STATION ASCENTS OF THE INSTITUT FUER METEOROLOGIE UND GEOPHYSIK OF THE FREIE UNIVERSITAET BERLIN, FEBRUARY 1967 [METEOROLOGISCHE ABHANDLUNGEN. BAND 76, HEFT 8: ERGEBNISSE DER AUFSTIEGE DER RADIOSONDENSTATION DES INSTITUTS FUER METEOROLOGIE UND GEOPHYSIK DER FREIEN UNIVERSITAET BERLIN IM JAHRE 1967, FEBRUARY]
Richard Scherhag, et al 1967 94 p refs In GERMAN; ENGLISH summary

Results of radiosonde flights are presented. Extreme and mean values of the temperature, geopotential, pressure, wind data, refractivity, density, pseudopotential temperature and velocity of sound for all standard pressure surfaces and for several height levels, the tropopause, and the freezing level were obtained. Author

N68-15365# Chicago Univ., Ill. Dept. of the Geophysical Sciences.
MESOSCALE ASPECTS OF OROGRAPHIC INFLUENCES ON FLOW AND PRECIPITATION PATTERNS
Tetsuya Fujita Jun. 1967 23 p refs
(Contract AF 19(604)-7259; Grant CWB-WBG-34)
(SMRP-RP-67; AD-662367)

Since horizontal dimensions of orography in relation to cloud formation and development are mostly in the mesoscale, we usually observe mesoscale nephsystems in areas with topographic influences. In addition to their barrier effects, mountains during the daytime act as effective high-level heat sources or as cloud generators. At night, however, they suppress the cloud formation and act as cloud dissipators. When these effects are combined with the height of the convective cloud base, which could be either higher or lower than that of the mountains, the patterns of orographic neph systems and precipitation are quite complicated. By using actual cases of cloud and precipitation measurements, detailed climatological and mesosynoptic patterns of clouds and precipitation are discussed. Author (TAB)

N68-15474# Air Weather Service, Washington, D. C.
U. S. NAVAL WEATHER SERVICE WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 4: CANADA–GREENLAND–ICELAND
Naval Weather Serv. Nov. 1967 716 p refs
(AD-662424)

The volume is part of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. This volume gives measured values of meteorological parameters for Canada, Greenland, and Iceland. TAB

N68-15558 Freie Univ., Berlin (West Germany). Institut fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 62, NUMBER 2: REPORTS ON THE AEROLOGY OF THE STRATOSPHERE OVER BERLIN, 1966 [METEOROLOGISCHE ABHANDLUNGEN. BAND 62, HEFT 2: BEITRAEGE ZUR AEROLOGIE DER STRATOSPHAERE UEBER BERLIN IMJAHRE 1966] Part 2, Second Quarter
Edgar Maedlow and Eugen Pantzke 1967 56 p refs In GERMAN; ENGLISH summary

Using the daily measurements of the radiosonde station of the Freie Universität of Berlin, time cross sections of temperature and the zonal and meridional wind components at heights above 30 km for April, May, and June 1966 were constructed. Weather in the 10-mb-region is discussed; and climatological data are given. Author

N68-16004# Air Weather Service, Washington, D. C. Environmental Technical Applications Center.
WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 5: AUSTRALIA–SOUTH PACIFIC–ANTARCTICA
Dec. 1967 552 p
(AD-662648)

The volume is part of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. This volume gives measured values of meteorological parameters for Australia, Antarctica, and for various South Pacific islands. TAB

N68-16021# National Weather Records Center, Asheville, N. C.
WORLD-WIDE AIRFIELD SUMMARIES. VOLUME 2, PART 2. MIDDLE EAST
Oct. 1967 400 p refs
(AD-662427)

The volume is the second of a series of compilations which is world-wide in scope. It consists of climatological summaries for selected airfields and for the climatic areas in which they are located. When complete, the series will include data for approximately 3000 stations. Volume II, part 2 includes countries in the Middle East from Iraq to Yemen, in alphabetical order. TAB

N68-16104*# Wisconsin Univ., Madison. Dept. of Atmospheric Sciences.
ON THE USE OF INTERMEDIATE INFRARED AND MICROWAVE INFRARED IN WEATHER SATELLITES
Konrad J. K. Buettner, Robert Dana, Kristina Katsaros, and William Kreiss Dec. 1967 31 p refs
(Grant NsG-632)
(NASA-CR-91902; AR-3) CFSTI: HC $3.00/MF $0.65 CSCL 04B

The following topics are discussed: (1) *Suggested Satellite Experiments*—implementation of nadir oriented orbiting telescopes for cloud and surface observations, microwave receiver for reflected solar light analysis, special filter for lightning spectrum, infrared detectors of quick response, and multispectral photography in the visible and near infrared for observation of salinity changes in ocean waters; (2) *Infrared Emissivity Experiment*—infrared thermometer and fast response stripchart recorder for cold box emissivity experiment; (3) *High Resolution Infrared Radiometer Adaptation*—modification of radiometer by transmission window for 3.5–4.1 micron radiation, and cooling system for low temperature level of −70°C; (4) *Influence of Rainfall on Surface Temperature and Salinity of the Ocean*—computer program for integration of heat and salt diffusion equation, test evaluation of model sea and rain apparatus, and climatological survey of rain temperature differences with underlying ocean; and (5) *Microwave Study*—construction of radiometer for 1.6 cm wavelengths observations, and ground-based zenith-viewing studies. G.G.

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N68-15331*# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.
GUIDANCE APPLICATIONS OF A QUASI-OPTIMUM CONTROL TECHNIQUE Final Report
Bernard Friedland, Sanford Welt, and Jack Richman 15 Nov. 1967 71 p refs
(Contract NAS8-20311)
(NASA-CR-61480) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This report describes the application of two versions of a quasi-optimum control technique, to two guidance problems. The first application is that of developing an explicit guidance technique for orbital injection, and comparing this technique to other guidance schemes, particularly the Iterative Guidance Mode (IGM). It was found that quasi-optimum control technique results in orbital injection at an earlier time than obtained by any of the other techniques to which it was compared, and it gives excellent results even when the IGM technique fails. The particular merit of the technique, however, is significant only in flights which are of longer duration than typical of near-term Saturn V flights. The second application is that of developing a guidance technique for very low-thrust vehicles. As a result of normal computational errors (truncation and round-off) the results achieved are inconclusive, but a slight advantage is seen by use of the quasi-optimum control technique. Author

N68-15366* United Aircraft Corporate Systems Center, Farmington, Conn.
A STUDY OF THE CRITICAL COMPUTATIONAL PROBLEMS ASSOCIATED WITH STRAPDOWN INERTIAL NAVIGATION SYSTEMS. VOLUME 2: COMPUTATIONAL ERROR ANALYSIS COMPUTER PROGRAM—USER'S MANUAL

23 Feb. 1967 275 p refs
(Contract NAS12-91)
(NASA-CR-86022; SCR-328-2) CFSTI: $3.00 CSCL 17G

This report describes the computational error analysis computer program which evaluates strapdown attitude computational errors and their effects upon navigational accuracy. The computational parameters evaluated by the program are tabulated. Errors are evaluated for a restrained sensor system operating in an unbounded navigation mode typical of boost and short term space missions. Author

N68-15665# New Zealand. Dept. of Scientific and Industrial Research, Wellington. Physics and Engineering Lab.
NAVIGATION BY SATELLITE
W. Ireland Sep. 1967 5 p refs
(TN-200) CFSTI: HC $3.00/MF $0.65

The feasibility is discussed of navigation by satellite of New Zealand-based ocean-going ships. It is concluded that the technique is not yet applicable in the merchant marine, but that it can be worthwhile in oceanographic survey. Reference is made to the Navigation Satellite System and Satellite Geophysics Program of the US Navy. Author (ESRO)

N68-15773*# Terra-Space Corp., Malibu, Calif.
NAVIGATION SYSTEMS OF SPACECRAFT
V. P. Seleznyev and M. L. Kirst 1965 33 p Transl. into ENGLISH from Voyennoye Izd. Min. Oborony SSSR Moscow, 1965 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92568) CFSTI: HC $3.00/MF $0.65 CSCL 17G

Abstracted data are presented from the book on the general problems and methods of space navigation, orbital flight elements of spacecraft, and related topics. Particular attention is given to the construction of complex, on-board navigation systems and ground facilities. Navigational parameters are outlined, and the instruments for acquiring navigational information are described. Self-contained and nonautonomous navigation systems are reviewed, and the instrumentation complexes are discussed for earth satellites, interplanetary spacecraft, rendezvous and docking, and interception of earth satellites. N.E.N.

N68-15846*# General Precision, Inc., Little Falls, N. J. Aerospace Research Center.
GUIDANCE APPLICATIONS OF A QUASI-OPTIMUM CONTROL TECHNIQUE Final Report
Bernard Friedland, Sanford Welt, and Jack Richman 15 Nov. 1967 71 p refs
(Contract NAS8-20311)
(NASA-CR-61499) CFSTI: HC $3.00/MF $0.65 CSCL 17G

This report describes the application of two versions of a quasi-optimum control technique, developed at the General Precision Aerospace Research Center, to two guidance problems. The first application is that of developing an explicit guidance technique for orbital injection, and comparing this technique to other guidance schemes, particularly the Iterative Guidance Mode (IGM) developed at the NASA Marshall Space Flight Center. It was found that General Precision's quasi-optimum control technique results in orbital injection at an earlier time than obtained by any of the other techniques to which it was compared, and it gives excellent results even when the IGM technique fails. The particular merit of the General Precision technique, however, is significant only in flights which are of longer duration than typical of near-term Saturn V flights. The second application is that of developing a guidance technique for very low-thrust vehicles. As a result of normal computational errors (truncation and round-off) the results achieved are inconclusive, but a slight advantage is seen by use of the quasi-optimum control technique. Author

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N68-15011# Battelle Memorial Inst., Columbus, Ohio.
PROGRESS RELATING TO CIVILIAN APPLICATIONS Annual Report, Jul. 1966–Jun. 1967
Donald L. Keller 1 Jul. 1967 206 p refs
(Contract W-7405-ENG-92)
(BMI-1809) CFSTI: HC $3.00/MF $0.65

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3. COATED-PARTICLE FUEL MATERIALS W. H. Pfeifer, N. E. Miller, and C. W. Townley 44 p refs (See N68-15014 06-22)

4. UO_2–PuO_2 FUEL DEVELOPMENT M. D. Houston and W. M. Pardue 10 p (See N68-15015 06-22)

5. EFFECTS OF HIGH BURNUP ON UO_2–CaO_2 and UO_2ZrO_2 FUELS E. O. Fromm, N. W. Ray, J. H. Saling, V. W. Storhok, and J. E. Gates 8 p ref (See N68-15016 06-22)

N68-15012# Battelle Memorial Inst., Columbus, Ohio.
URANIUM–PLUTONIUM NITRIDE FUELS FOR LMFBR APPLICATIONS
W. M. Pardue and R. A. Smith *In its* Progr. Relating to Civilian Appl. 1 Jul. 1967 95 p refs (See N68-15011 06-22)

The studies are conducted to evaluate the potential of mixed fuels for liquid-metal fast breeder reactor (LMFBR) applications. The program is divided into efforts involving the preparation of materials, property determinations, irradiation studies, and supporting studies. Preparation of nitride materials is undertaken by gas-solid reactions, melting of the constituents, and by carbothermic reduction of the uranium–plutonium oxides. Physical properties of importance for reactor design are determined, including volatility tendencies, conductivity, expansivity, and chemical stability of the fuels in contact with potential LMFBR cladding materials. The evaluation of the sodium bonding concept is a second major objective of the program. Nitride-fueled LMFBR systems are optimized in their performance when utilizing sodium exit temperatures of 1200°F and having linear heat ratings on the order of 20 to 30 kw per ft with heat fluxes of 1.5×10^6 to 2.00×10^6 Btu/(hr) (ft^2); however, the behavior of a thin sodium bond under these conditions is not well known. A significant amount of effort is thus devoted to experimental studies of sodium boiling, wetting, and film formation. Author

N68-15013# Battelle Memorial Inst., Columbus, Ohio.
IRRADIATION EFFECTS IN REACTOR CLADDING MATERIALS
R. A. Wullaert *In its* Progr. Relating to Civilian Appl. 1 Jul. 1967 42 p refs (See N68-15011 06-22)

The irradiation and heat treatment effects on the mechanical properties of stainless steels and other potential cladding materials for liquid-metal-cooled fast reactors were investigated. Data on the

tensile properties, ductility, and chemical analyses for irradiated and unirradiated specimens are tabulated. Preparations to determine the effects caused by a predominantly fast flux and a mixed fast and thermal flux are mentioned. The heat treatments were carried out at 800°, 1000°, and 1200°F, and the data are extensively graphed and tabulated. N.E.N.

N68-15014# Battelle Memorial Inst., Columbus, Ohio.
COATED-PARTICLE FUEL MATERIALS
W. H. Pfeifer, N. E. Miller, and C. W. Townley *In its* Progr. Relating to Civilian Appl. 1 Jul. 1967 44 p refs (See N68-15011 08-22)

Emphasis is directed toward the development of ceramic-coated plutonium-base particle fuels for general utilization. The primary objective is to achieve satisfactory resistance to radiation damage, thermal shock, and chemical interactions, using the thinnest possible coatings. The studies reported are of three types: (1) materials-fabrication studies which have the objective of producing and characterizing fuel particles and coated fuel particles for the program; (2) out-of-pile studies of the coated particles to determine their limitations in terms of fuel-coating chemical compatibility, thermal-shock resistance, fuel diffusion in the coatings, and fission-product release; and (3) irradiation studies to evaluate the performance of the coated particles in a radiation environment. The feasibility of coating fuel particles with graphite by precipitation from liquid metal solutions was also investigated. Author

N68-15015# Battelle Memorial Inst., Columbus, Ohio.
UO_2–PuO_2 FUEL DEVELOPMENT
M. D. Houston and W. M. Pardue *In its* Progr. Relating to Civilian Appl. 1 Jul. 1967 10 p (See N68-15011 08-22)

Fuel fabrication parameters and material characterization techniques for the gas-cooled fast breeder reactor were established and are described. The compositions were prepared by mechanically blending natural UO_2, fully enriched UO_2, and PuO_2, and pellets were prepared by cold pressing and sintering techniques. The characterization data for the fuel material and for the completed fuel element are tabulated. N.E.N.

N68-15016# Battelle Memorial Inst., Columbus, Ohio.
EFFECTS OF HIGH BURNUP ON UO_2–CeO_2 AND UO_2–ZrO_2 FUELS
E. O. Fromm, J. W. Ray, J. H. Saling, V. W. Storhok, and J. E. Gates *In its* Progr. Relating to Civilian Appl. 1 Jul. 1967 8 p ref (See N68-15011 08-22)

Fuel specimens of 10 and 22 w/o fully enriched UO_2 in solution in CaO-stabilized ZrO_2, and 10 and 25 w/o UO_2 in solution in CeO_2 were irradiated to burnups from 4.4 to 28×10^{20} fissions per cm^3. Axial swelling was observed in all specimens, and fission gas release varied from 22 to 96 percent. It is considered that the fuel components separated, resulting in the outer regions becoming rich in UO_2. The research on postirradiation examination is summarized, and the irradiation conditions and postirradiation data are tabulated. N.E.N.

N68-15034# Gesellschaft fuer Kernforschung M. B. H., Karlsruhe (West Germany).
COMPARISON OF MEASUREMENTS IN SNEAK-1 AND ZPR 3-41
L. Barleon, R. Boehme, K. Boehnel, M. Edelmann, P. Engelmann *et al* Oct. 1967 26 p refs Presented at the IAEA Symp. on Fast Reactor Physics and Related Safety Problems, Karlsruhe, W. Germany, 30 Oct.–3 Nov. 1967
(KFK-629; SM-101/8; EUR-3670)

The general design features and core configuration are described for Sneak, a fast critical facility which was built to support basic research in fast reactor physics. Critical mass measurements of Sneak were compared with calculated data obtained from Zero Power Reactor-3 (ZPR-3). Corrections were introduced for irregular core outline, partially inserted control rod, heterogeneity, and shape factor. A proton recoil counter along with foil irradiations were used to measure neutron spectrum in the central cavity of Sneak. Kinetics parameters and neutron pulsed source measurements were also taken. Most experimental results obtained with the Sneak facility were found to agree with those of the ZPR-3. B.S.D.

N68-15187 Kernforschungszentrum, Karlsruhe (West Germany). Institut fuer Neutronenphysik und Reaktortechnik.
THE LONG TIME BEHAVIOR OF FAST POWER REACTORS WITH PLUTONIUM RECYCLING
A. Jansen Oct. 1967 25 p refs Presented at the Symp. on Fast Reactor Phys. and Related Safety Probl., 30 Oct.–3 Nov. 1967 Sponsored by EURATOM
(KFK-630; SM-101/16; EUR-3674.E)

Blanket plutonium is introduced into a closed fuel cycle to study the overall time behavior caused by the fuel burnup in the reactor and the internal and external fuel management, with emphasis on the behavior of the reactor during plutonium recycling. Conditions for reactor operation, and fuel burnup equations are used in the mathematical formalism for calculating the long-time behavior of a sodium cooled reactor. The uranium and plutonium core outputs of the axial and radial blankets are determined. Composition of the refabricated fuel elements and breeding gain are given along with 2N linear algebraic equations for calculating initial compositions of the fuel elements. Numerical results reveal the dependence of the time behavior of the plutonium composition in the fuel elements on the fuel burnup and internal and external fuel managements. B.S.D.

N68-15197*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
ANALYSIS OF URANYL FLUORIDE SOLUTION REACTORS CONTAINING VOIDED TUBES
Wendell Mayo Washington Feb. 1968 26 p refs
(NASA-TN-D-4270) CFSTI: HC $3.00/MF $0.65 CSCL 18L

Critical experiments with fully enriched (93.2 percent uranium 235) uranyl fluoride–water solution reactors that contain arrays of large-diameter void tubes have been analyzed satisfactorily. This study evaluates a calculational method that involves the direct application of widely used multigroup computer programs and techniques to cases of extreme heterogeneous voids. Experimental critical solution heights for cores that contain no void tubes and for 19, 31, and 37 void tubes with a 7.658-centimeter diameter were obtained by using the NASA Zero Power Reactor-II facility. Both unreflected cores and cores radially reflected with 15.24 centimeters of water were considered. The void arrays with triangular lattice pitches of either 9.652 or 10.922 centimeters were centrally located in the 76.2-centimeter-diameter core tank. The critical heights of the voided reactors ranged from 21 to about 84 centimeters. Author

N68-15351# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.
AEC FUELS AND MATERIALS DEVELOPMENT PROGRAM Progress Report, 1 May–31 Jul. 1967
29 Sep. 1967 155 p refs
(Contract AT(40-1)-2847)
(GEMP-69; PR-69) CFSTI: HC $3.00/MF $0.65

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8. HIGH-TEMPERATURE RESEARCH ON CARBIDES FOR FUEL AND STRUCTURAL APPLICATIONS J. F. White and E. F. Juenke p 123–133 refs (See N68-15359 06-17)

9. PHYSICO-CHEMICAL STUDIES OF CLAD UO_2 IN POTENTIAL MELTDOWN ENVIRONMENTS J. F. White p 135–148 refs (See N68-15360 06-06)

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11. PHYSICAL METALLURGY OF REFRACTORY-METAL ALLOYS C. G. Collins p 153–161 refs (See N68-15362 06-17)

N68-15352# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

HIGH TEMPERATURE REACTOR MATERIALS RESEARCH

J. B. Conway and P. N. Flagella *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 11–26 refs (See N68-15351 06-22)

High temperature physical and mechanical properties were measured and evaluated for refractory materials for use in fueled and nonfueled reactor applications at temperatures between 1000° and 3000°C. Creep rupture studies are reported for rhenium, W-30 Re-30 Mo, and tungsten. Creep analysis was performed for arc-cast tungsten by using constant load tests, and a computer program was written to analyze experimental strain-time data. Development of substructure in metals during high temperature deformation was studied with tungsten samples annealed before creep testing. In general, it was found that the holder ends all have similar microstructures, consisting of very large grains and subgrains, with virtually no dislocations in the matrix. Electrical resistivity and thermal conductivity data are included for W-25 Re. M.W.R.

N68-15353# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

RADIATION EFFECTS ON FAST REACTOR CLADDING AND STRUCTURAL MATERIALS

J. Moteff, F. Kingsbury, and J. P. Smith *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 27–62 refs (See N68-15351 06-22)

Studies were undertaken to determine the effect of time, temperature, and stress dependent properties of selected heat-resistant alloys and refractory metals; as well as to identify changes in these properties and develop necessary remedial measures. Neutron irradiation effect is being studied on the creep rupture, tensile, hardness, and resistivity properties; and theoretical calculations on the nature of neutron-induced defects and their migration behavior are being made. A transmission electron microscope is being used to observe these defects. Creep rupture tests are reported for Mo rods and sheets, hot hardness studies are being performed to determine the effect of substructure on the generation of irradiation-induced defects in tungsten, and isochronal resistivity is being studied on Mo and W. Creep rupture tests were made following irradiation to determine heat resistance of Hastelloy X, Incoloy 800, Hastelloy R-235, and FE-15 CR-4 Al-1 Y. M.W.R.

N68-15354# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

HIGH TEMPERATURE THERMOCOUPLE AND ELECTRICAL MATERIALS RESEARCH

E. S. Funston and W. C. Kuhlman *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 63–69 refs (See N68-15351 06-22)

Properties of reliable high temperature thermocouple, electrical, and electronic materials are being studied to provide instrumentation and electrical components for long-life, high temperature reactors. High temperature thermocouple characteristics were studied for both W alone and W-25 Re; and reactor-induced thermoelectric changes are reported for W-0.5 Os and W-25 Re thermocouples. M.W.R.

N68-15357# General Electric Co., Cincinnati, Ohio. Nuclear Materials and Propulsion Operation.

ADVANCED LONG LIFE REACTOR FUEL CLADDING AND STRUCTURAL MATERIALS DEVELOPMENT

F. C. Robertshaw *In its* AEC Fuels and Mater. Develop. Program 29 Sep. 1967 p 91–108 refs (See N68-15351 06-22)

Improved fuel element cladding and structural materials are being developed for fast breeder reactor applications; and Fe, Fe–Cr, and Cr base alloys are being studied as possible replacements for austentic steels for reactor fuel cladding and structure. Tensile and stress rupture properties are reported; and various elements considered as potential solution strengtheners for experimental Fe base alloys are tabulated, including their elastic moduli at 750°C and their activation energies. Creep rupture data are given for Fe–Cr–Al–Y alloys in air; and their aging characteristics at 450°C are discussed. Charpy V-notch impact data for these alloys are graphed, and effects of processing on their structure is considered. Stress rupture properties are tabulated for warm-rolled Cr base alloys in argon; and their environmental compatability and relation stability are discussed. M.W.R.

N68-15409# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SHIELDING IN NUCLEAR ENGINEERING: COLLECTION OF ARTICLES

27 Apr. 1967 55 p refs Transl. into ENGLISH from Zashchita Pokrytiya v Atomnoy Tekhn. Sb. Statey (USSR), 1963 p 5–10, 93–97, 126–136, 144–147, and 260–270
(FTD-HT-66-691; AD-662586)

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4. THE APPLICATION OF EPOXY COATINGS FOR PROTECTION OF METALLIC AND CONCRETE SURFACES V. B. Tikhomirov and Ye. A. Panevkina p 27–32 refs (See N68-15413 06-22)

5. METERS AND DOSIMETERS FOR STUDY OF PROTECTION AND THE PROTECTIVE PROPERTIES OF MATERIALS V. N. Avayev, G. A. Vasil'yev, Yu. A. Yegorov, V. A. Kucheryayev, Yu. V. Orlov, et al p 33–51 refs (See N68-15414 06-22)

N68-15410# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE ROLE OF PROTECTIVE SHIELDING IN RADIATION SAFETY SYSTEMS

S. M. Gorobinskiy *In its* Shielding in Nucl. Eng: Collection of Articles 27 Apr. 1967 p 1–7 (See N68-15409 06-22)

The entire range of the problem of surface contamination is examined and the causes for such contamination are listed and discussed. Particular attention is given to the relation which exists between the degree of contamination of equipment and structural surfaces and aerosol activity in the air. The views of different authors on this problem are examined and criticized. The author advances the premise that one of the fundamental postulates of radiation security must be the radical reduction of the possibility of contamination of the surfaces of production shops and equipment. It is pointed out that, at the present-day state-of-the-art, the primary emphasis in this direction must be layed on the utilization of such construction and finishing materials, from which contamination can be easily removed. The fundamental requirements of good shielding materials are discussed, with the author calling for the replacement of stainless chrome–nickel steel by more accessible and more easily deactivated materials. The shielding potential of different polymer and lac dye materials are discussed and the advantages of formula 57-40 masticated rubber for this purpose are analyzed briefly. Author

N68-15411# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

USE OF SHEETS WITH AN ADHESIVE LAYER AS PROTECTIVE COATING AGAINST RADIOACTIVE CONTAMINATION

T. G. Ivanova and N. I. Gus'kova *In its* Shielding in Nucl. Eng: Collection of Articles 27 Apr. 1967 p 8–13 (See N68-15409 06-22)

Roll-film materials for shielding purposes against radioactive contamination were developed on a polyethylene and polyvinylchloride base. The following considerations were fundamental: 1) the formula of the base film must provide minimal sorption and easy desorption (deactivation) of radioactive contaminants; 2) the formula of the non-siccative glue must have good adhesion to various construction materials: concrete, metal, plaster; 3) the films with the adhesive layers must be capable of easy application to the surfaces to be shielded and, in case of necessity, easy removal and replacement. On the basis of experiments, the authors reached the following conclusions: 1) Polyethylene and polyvinylchloride films with an adhesive layer may be recommended for use, in working with radioactive materials, as temporary, easy-to-replace, shielding for vertical surfaces and for laboratory equipment, as a protection against radioactive contaminants and corrosion. 2) The formulas chosen for the base film provide deactivation of the protective shielding up to maximum permissible levels with mean levels contamination. 3) The formula selected for the glue layer provides good strength of adhesion of the films to metallic surfaces and satisfactory adhesion to cement and plastered surfaces, if these surfaces are prepared in accordance with certain recommendations discussed in the article. Author

N68-15412# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

INVESTIGATION OF ORGANIC COATING MATERIALS FOR PROTECTIVE COATING FROM RADIOACTIVE CONTAMINATION

S. M. Gorobinskiy, Z. Ye. Panfilova, A. D. Spiribonov, L. M. Nosova, and N. A. Shubrenko *In its* Shielding in Nucl. Eng: Collection of Articles 27 Apr. 1967 p 14–26 refs (See N68-15409 06-22)

Lacquered materials are widely used for finishing processes in factories and technical equipment. The advantage of lacquered materials for the shielding of construction materials and technological equipment from radioactive contamination is the continuous, jointless coating of the surface during any of its configurations. The present investigation showed that the desorptive properties of lacquer coatings depend primarily on their chemical composition. Lacquers with oils and alkali-oil should not be used for surfaces contaminated by radioactive waste. It is advisable to use 1-20-61 enamels on an SVKh-40 base and commercial enamels on an SVKh-40 base with lacquer coatings. The most efficient protection of concrete against contamination is a shielding on a base of high-molecular epoxy resins. It is possible to make shielding compounds consisting of lacquer coatings which ensure easy and complete decontamination (washing away of radioactive waste). Author

N68-15413# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE APPLICATION OF EPOXY COATINGS FOR PROTECTION OF METALLIC AND CONCRETE SURFACES [PRIMENENIYE EPOKSIDNYKH POKRYTIY DLA ZASHCHITY METALLICHESKIKH I BETONNYKH POVERKHNOSTEY]

V. B. Tikhomirov and Ye. A. Panevkina *In its* Shielding in Nucl. Eng: Collection of Articles 27 Apr. 1967 p 27–32 refs (See N68-15409 06-22)

Shieldings made of epoxy resins are the most widely used protection against corrosion for buildings, communications, and equipment, including nuclear devices. In the U.S.A., epoxy shieldings are used to protect steel and concrete surfaces from a radiation of 10^9 rad and the simultaneous action of boiling water. Of the resins being manufactured in the Soviet Union, the high-molecular epoxy resins can be used for nuclear shielding. This type of epoxy resin has the best physical and mechanical properties. Different compositions of epoxy resins and solvents are listed in the article. Both air and heat drying can be used for them. An addition of 1% of melamino–formaldehyde resin is used to lower the surface tension of the epoxy compound, thus improving the coating. The viscosity of the resin is also important for the coating method. Common spray guns can be used for epoxy spraying. Author

N68-15414# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METERS AND DOSIMETERS FOR STUDY OF PROTECTION AND THE PROTECTIVE PROPERTIES OF MATERIALS

V. N. Avayev, G. A. Vasil'yev, Yu. A. Yegorov, V. A. Kucheryayev, Yu. V. Orlov et al *In its* Shielding in Nucl. Eng: Collection of Articles 27 Apr. 1967 p 33–51 refs (See N68-15409 06-22)

Investigations that were conducted showed that heavy concrete gives more effective protection against neutrons and gamma-radiation. The addition of magnesium to the concrete somewhat increases the shielding properties as compared to concrete of Portland cement in the same density. The introduction of Boron compounds into the concrete greatly reduces the flow of thermal neutron. Author

N68-15469# Boeing Co., Seattle, Wash.
SURVEY OF THERMO-RADIOISOTOPE PROPULSION AND INTEGRATED POWER FOR THE EXPLORATION OF CISLUNAR AND PLANETARY SPACE [EINE UEBERSICHT THERMO-RADIOISOTOPER ANTRIEBE UND INTEGRIERTER ENERGIEERZEUGER FUER DIE ERFORSCHUNG DES ERD-NAHEN UND INTERPLANETAREN RAUMES]
Jacob B. Romero and Rudolf H. Reichel 1966 29 p refs Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Ger., Oct. 1966
(DGRR/WGLR Paper-66-072) CFSTI: HC $3.00/MF $0.65

Various aspects associated with the application of radioisitopes to spacecraft propulsion and integrated power are reviewed, and the status of appropriate programs is assessed. Potential radioisotope heat sources are compared on the basis of availability, cost, radiation characteristics, chemico–physico properties, half-life, and performance. Analytical studies include application of radioisotopes to both manned and unmanned missions. Application of radioisotope thrusters for reaction control in earth-orbital missions can result in propellant mass savings of 40 to 50% in some cases. Radioisotope thrusters also show exceptional capabilities for planetary flyby and orbiter missions when based on present booster concepts.
Author (ESRO)

N68-15493# Westinghouse Electric Corp., East Pittsburgh, Pa. Atomic Power Div.
CALCULATION OF LOCAL SPECTRUM AND FUEL COMPOSITION CHARACTERISTICS
P. G. Lacey Feb. 1967 100 p refs
(Contract AT(30-1)-3017)
(WCAP-6066) CFSTI: HC $3.00/MF $0.65

An evaluation of reaction-rate ratios in reactor lattices, including the effect of local neutron flux variations which occur as a result of discontinuities in the regular pattern of fuel rods, is given. This evaluation of the so-called microscopic parameters δ^{25}, ρ^{28}, δ^{26}, MCR and CR (which are actually reaction-rate ratios) embodies: the determination of reaction-rate ratios at beginning-of-life in cold, critical-experiment lattices, including experiment/theory correlations in both asymptotic and perturbed lattice regions; the determination of the change, with fuel depletion, of reaction-rate ratios in an operating core, including correlation with preliminary data obtained by destructive analysis of selected fuel samples from YANKEE Core I. The results of the calculations, the experimental data, and the experiment/theory correlations are presented, along with discussion of the methods of analysis. Inferences concerning the ability of the calculational procedure to predict fuel depletion and net Pu production are made.
Author (NSA)

N68-15506# Atomic Energy of Canada, Ltd., Chalk River (Ontario).
LATTICE MEASUREMENTS WITH 28-ELEMENT NATURAL UO_2 FUEL ASSEMBLIES. PART 2: RELATIVE TOTAL NEUTRON DENSITIES AND HYPERFINE ACTIVATION DISTRIBUTIONS IN A LATTICE CELL
K. J. Serdula and R. E. Green Aug. 1967 70 p refs
(AECL-2772) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.50

Relative total neutron densities and hyperfine manganese activation distributions have been derived from measurements in a triangular array of 55 28-element natural UO_2 fuel assemblies in D_2O moderator. Results are presented for lattice pitches in the range 20 to 40 cm. Simulated "coolants" used were: D_2O of moderator purity, air to simulate loss of coolant condition, and an organic liquid, HB-40. The results show that the total neutron density depression across the cell is smallest for air and largest for organic (HB-40) coolant, as expected from the absorption and scattering properties of the coolant materials.
Author

N68-15643*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL DETERMINATION OF NEUTRON FLUXES IN PLUM BROOK REACTOR HB-6 FACILITY WITH USE OF SULFUR PELLETS AND GOLD FOIL
John M. Bozak and Michael P. Godlewski Washington Feb. 1968 23 p refs
(NASA-TM-X-1497) CFSTI: HC $3.00/MF $0.65 CSCL 18M

Fast and thermal neutron fluxes were measured in the test cavity outside the HB-6 beam port in the Plum Brook reactor, with the use of sulfur pellets and gold foils. The dependence of flux on reactor power level, shim-control-rod position, water attenuator tank configuration, position in the test cavity, and perturbations by other experiments was investigated. Based on the measurements taken, the thermal and fast neutron fluxes for any combination of these parameters can be determined. Standard fluxes (which correspond approximately to an average flux in the test cavity at full reactor power) were 1.4×10^6 neutrons per second per square centimeter (nv) for thermal neutrons ($E\leq0.4$ eV or 0.64×10^{-7} pJ) and 8.2×10^6 neutrons per second per square centimeter (nv) for fast neutrons ($E\geq2.48$ MeV or 0.398 pJ). The flux errors are estimated at ±38 and ±35 percent for thermal and fast neutrons.
Author

N68-15684# National Engineering Science Co., Pasadena, Calif.
A METHOD FOR EVALUATION OF RADIATION SHIELDING DESIGN Final Report
M. A. Suarez 31 Jan. 1967 142 p refs Prepared for Stanford Res. Inst., Menlo Park, Calif.
(SN-255; AD-662059)

The report converts certain graphical information relating to fallout protection of various structures to equations, thereby making it possible to computerize engineering calculations. Discrepancies between graphical and numerical methods are also analyzed.
Author (TAB)

N68-15753# Atomic Energy Establishment, Winfrith (England).
HIGH TEMPERATURE REACTORS AND THE DRAGON PROJECT, SESSION 2. DEVELOPMENT OF THE HIGH-TEMPERATURE GAS-COOLED REACTOR AND THE PEACH BOTTOM HIGH-TEMPERATURE GAS-COOLED REACTOR PROTOTYPE
Robert B. Duffield May 1966 35 p refs Presented at the BNES Symp., 23 May 1966
(Proj. Dragon)
(DP-425, Pt. 2) CFSTI: HC $3.00/MF $0.65

A description is given of the Peach Bottom atomic power station, particularly of the nuclear steam supply system. Results are given of the low-power tests that have been carried out.
NSA

N68-15765# Argonne National Lab., Ill.
REACTOR DEVELOPMENT PROGRAM Progress Report
30 Jun. 1967 140 p refs
(Contract W-31-109-ENG-38)
(ANL-7342) CFSTI: HC $3.00/MF $0.65

Summaries of progress are presented concerning the EBWR Pu recycle program, EBR-II operation and shutdown, physics experiments in ZPR-3, development of ZPPR and AARR, burnup measurements for fast reactors, Na technology, fuel development and processing, reactor physics development, fuels and cladding development and fabrication, heat and fluid flow, fluoride volatility process development, liquid metal direct conversion generator research, and research on nuclear safety.
NSA

N68-15779# Atomic Energy Establishment, Winfrith (England). S.G.H.W. Development Div.

MAGOG—A THREE DIMENSIONAL, TWO GROUP DIFFUSION CODE WITH BURNUP

D. Hopkins and D. B. Oakes 1967 43 p refs

(AEEW-R-531) CFSTI: HC$3.00/MF$0.65

MAGOG is a three dimensional, two group diffusion code written in E2 FORTRAN for the English Electric Winfrith KDF.9 and in S2 FORTRAN for the Aldermaston STRETCH Computers. Burnup is simulated through the use of a library of nuclear data generated by the METHUSELAH cell burnup code. The flux solution in each neutron group is obtained using a finite difference expansion allied to a source iteration technique, acceleration procedures being used to speed up the solution. A point rating distribution generated from the flux solution is used to advance each irradiation value independently. A channel power map is then evaluated from the rating distribution. Zero flux or zero flux gradient boundary conditions are included to permit the representation of whole cores or sub-units. The boundary conditions are imposed in accordance with three geometric options (1) supercell (2) quarter core (3) whole core. Three reactivity control options and an automatic fuel changing routine are included in the code. Author

N68-15780# Atomic Energy Establishment, Winfrith (England). Water Reactor Physics Div.

MEASUREMENTS OF MATERIAL BUCKLING AND DETAILED REACTION RATES IN A SERIES OF LOW ENRICHMENT UO_2 FUELLED CORES MODERATED BY LIGHT WATER

W. A. V. Brown, D. J. Skillings, G. D. Burholt, W. N. Fox, and C. F. George 1967 145 p refs

(AEEW-R-502) CFSTI: HC$3.00/MF$0.65

The effect of temperature and lattice pitch on the material buckling and reaction rates in a number of low enrichment UO_2 fuelled cores moderated by light water have been measured in the reactor DIMPLE at Atomic Energy Establishment, Winfrith. The experiments are described in detail and the results presented. Author

N68-15783# Oak Ridge National Lab., Tenn. Health Physics Div.

ENERGY AND ANGULAR DISTRIBUTION OF NEUTRONS AND GAMMA RAYS: OPERATION BREN

J. H. Thorngate, J. A. Auxier, F. F. Haywood, and S. Helf Feb. 1967 93 p refs

(Contract W-7405-ENG-26)

(CEX-62.12) CFSTI: HC$3.00/MF$0.65

In order to understand better the transmission and scattering of radiation in air, a series of measurements were made to determine the energy and angular distributions at large distances from the Oak Ridge National Laboratory Health Physics Research Reactor and an 800-Ci ^{60}Co source. Both sources were positioned at various elevations on a 1527-ft tower while data were acquired by detectors located in collimators at either 750 or 1000 yd from the base of the tower. Good measurements were obtained of neutron and gamma-ray doses from the HPRR and gamma doses from the ^{60}Co source as a function of angle of incidence. Scintillation spectra of the gamma rays from the ^{60}Co source were also obtained. No useful spectrum information was obtained from the HPRR. Author (NSA)

N68-15792*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

SMALL HIGH-TEMPERATURE NUCLEAR REACTORS FOR SPACE POWER

Edward Lantz, Wendell Mayo, Robert M. Westfall, and John L. Anderson, Jr. Washington Feb. 1968 19 p refs

(NASA-TN-D-4371) CFSTI: HC$3.00/MF$0.65 CSCL 18L

As a first step in a comparison of the relative performance of nuclear reactors and of other thermal sources for space power systems, criticality calculations were made for small, cylindrical, lithium-cooled reactors which use tungsten as the structural material. The nuclear fuels considered were plutonium-239, uranium-233, and uranium-235. These fuels were assumed to be in the form of pure metals, nitrides, and oxides. The radial neutron reflectors considered were beryllium oxide, molybdenum, and carbon. The calculations revealed that the smallest cores are those fueled with metallic U^{233} and Pu^{239}. These cores can be as small as 11 centimeters in diameter and 30.5 centimeters long; however, at desired operating temperatures these cores would contain molten fuel. The smallest solid fuel core contains uranium-233 nitride ($U^{233}N$) in a core 13.5 centimeters in diameter and 30.5 centimeters long. The reactor diameters increase about 2.5 centimeters when the oxide fuel is used in place of the nitride. Cores fueled with U^{235} are considerably larger than those fueled with U^{233} Author

N68-15806*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

METHOD FOR CALCULATING ALLOWABLE CREEP STRESS IN LINEARLY INCREASING STRESS ENVIRONMENT

Charles L. Whitmarsh, Jr. Washington Jan. 1968 12 p refs

(NASA-TN-D-4352) CFSTI: HC$3.00/MF$0.65 CSCL 18I

An analytical technique was developed to calculate the allowable design stress for a specified creep limit of a material under conditions of linear stress buildup and constant temperature. The analysis utilizes constant-stress creep data in the integration of a stress-dependent creep rate over the material history. Allowable design stress limits for 1-percent creep of refractory metals in the temperature range 800° to 1600°K are increased by 25 to 57 percent when compared with calculations based on the constant end-of-life stress condition. Author

N68-15822 Gesellschaft fuer Kernforschung M.B.H., Karlsruhe (West Germany). Inst. fuer Neutronenphysik und Reaktortechnik.

THE GROUP CROSS-SECTION SET KFK-SNEAK. PREPARATION AND RESULTS

H. Bachmann, H. Huschke, E. Kiefhaber, B. Krieg, H. Kuesters, et al Oct. 1967 30 p refs Presented at the Intern. Symp. on Fast Reactor Physics and Related Safety Problems, Karlsruhe, W. Germany, 30 Oct.–3 Nov. 1967

(KFK-628; SM-101/12; EUR-3672-e)

The methods used in calculating group constants are surveyed, and the main calculational techniques used to determine the elastic removal group constants and the effective microscopic group cross section are described. The Sneak-set of group constants, based on reevaluated data for H, C, O, Na, Al, Cr, Fe, Ni, U^{235}, U^{238}, and Pu^{239}, are compared with the basic data to show the main differences. Two methods used for calculating the elastic moderation are assessed: method A is based on the σ_0-concept; method B calculates directly the shielded macroscopic elastic removal from the Erdak-file. Comparison of the theoretical results with the measured results for the fast critical assembly Sneak 3A-1 are considered encouraging. It was concluded that the reasons for the better agreement of experiment and theory is due to the low fission and capture data of U^{235} included in the Sneak-set, and to an improved description of elastic moderation (method B). M.G.J.

N68-15855*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NUCLEAR DESIGN DATA FOR EXPERIMENTS TO BE CONDUCTED IN HORIZONTAL THROUGH HOLE 1 OF THE PLUM BROOK REACTOR
Robert G. Rohal, Patrick M. Finnegan, and E. J. Ciesla Washington Feb. 1968 31 p refs
(NASA-TM-X-1509) CFSTI: HC$3.00/MF$0.65 CSCL 18M

Three irradiation facilities have been designed for use in the Horizontal Through Hole 1 (HT-1) of the Plum Brook Reactor (PBR). These facilities are the Inpile Helium-Cooled Loop, the Single-Pass Argon-Cooled Facility, and the Inpile Capsule Facility. Experiments were conducted in HT-1 of the Plum Brook Mockup Reactor (MUR) to provide data for experiments employing these facilities. In these experiments, mockups of the three facilities were used to obtain the following information: (1) the thermal-neutron flux, which ranged from approximately 1×10^{9} to 4×10^{9} neutrons per square centimeter per second per kilowatt of reactor power along the axis of the inpile tubes; (2) the fission power in mockups of flat-plate fuel elements composed of tungsten and approximately 10 to 25 grams of fully enriched uranium, which ranged from approximately 0.04 to 0.10 watt per gram of enriched uranium per kilowatt of reactor power; (3) the gamma heating in the inpile tube structure, which ranged from approximately 0.5×10^{-4} to 1.0×10^{-4} watt per gram per kilowatt of reactor power; (4) the reactivity worth of the mock fuel elements and inpile tubes in both normal and accident conditions, which ranged from −4 to −40 cents, respectively. Author

N68-15886# Atomic Weapons Research Establishment, Aldermaston (England).
RESOLUTION CORRECTIONS TO NEUTRON SPECTROMETRY BY THE PULSED SOURCE TIME OF FLIGHT TECHNIQUE
W. J. Paterson and K. L. Shutler Sep. 1967 20 p refs
(AWRE-O-8/67) HMSO: 3s

This report describes the resolution correction method in the code TOF, used in the analysis of time of flight measurements on the VERA reactor. An account is given of some investigations, using the code TOFTEST, to determine the range of validity of this correction applied to typical results. Author

N68-16056*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
CALCULATIONS TO SUPPORT OPERATION OF THE PLUM BROOK REACTOR
Harry J. Reilly, John H. Lynch, and Steven R. Borbash Washington Feb. 1968 25 p refs
(NASA-TM-X-1496) CFSTI: HC$3.00/MF$0.65 CSCL 18I

Several calculations that have aided operation of the Plum Brook Reactor were described. First, a simple mathematical model and the resulting calculations which were done to study fuel utilization are described. A decision to buy 240-gram uranium 235 fuel elements and to use them three times each was made on the basis of the study. The power distribution in the mixed loading is discussed and is observed to be more uniform than that in a uniform fuel loading. Charge life weight factors are then derived; the derivation differs in approach and in results from previous derivations by others. Finally, a "xenon clock" on-line computer program in use at the Reactor is discussed, and an approximation useful for hand calculations of complex histories is derived. Author

N68-16073# European Atomic Energy Community, Brussels (Belgium).
INFLUENCE OF IRRADIATION ON ADMISSIBLE WATER IN LEAKAGE IN HTGCR
L. J. Valette 1967 17 p refs
(EUR-2782-e, Annex)

Consideration is given to the following areas in a study of the influence of irradiation on admissible water inleakage in high temperature gas cooled reactors: (1) steady state concentration of impurity in the primary circuit, (2) admissible water concentration in the core, (3) admissible water inleakage, and (4) irradiation effects on the graphite oxidation. It is concluded that the temperature dependence of the radiolytically induced graphite oxidation is such that for one specified admissible local attack the water inleakage can be increased. C.T.C.

N68-16096# Idaho Nuclear Corp., Idaho Falls.
MTR REFLECTOR GRAPHITE AFTER 13 OPERATING YEARS
E. Fast, S. Cohen, and G. V. Wheeler 23 Jun. 1967 22 p ref Presented at 8th Bien. Conf. on Carbon, Buffalo, 19–23 Jun. 1967
(Contract AT(10-1)-1230)
(CONF-670640-1) CFSTI: HC$3.00/MF$0.65

The stored energy releasable at low temperatures in the MTR graphite reflector is approaching saturation and does not appear to present a serious risk to continued operation for any credible operational failure. The approach to any condition that conceivably would initiate a spontaneous energy release is sufficiently gradual that adequate corrective measures can be taken. The buildup of radiation damage is consistent with that expected from the operating temperature and measured fast flux. Good agreement is found with previous work to which the present measurements can be compared. The maximum temperature reached in spontaneous release would still be several hundred degrees centrigrade below ignition point. Slow oxidation was measured with statistical significance. The temperature and fast neutron flux levels as well are much lower than that at which weight loss rate has previously been measured. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Spera Radiation.

N68-16097# ARO, Inc., Arnold Air Force Station, Tenn.
IN SITU MEASUREMENT OF THICKNESS AND OTHER PROPERTIES OF CARBON DIOXIDE CRYODEPOSITS BY OPTICAL TECHNIQUES Technical Report, Jan. 1–Jul. 31, 1967
K. E. Tempelmeyer, B. E. Wood, and D. W. Mills, Jr. Arnold Eng. Develop. Center Dec. 1967 59 p refs
(Contract AF 40(600)-1200)
(AEDC-TR-67-226; AD-662869)

Measurements of interference patterns in filtered light reflected from thin 77K CO2 cryodeposits are reported. Analysis indicated that these patterns are a result of interference between light rays scattered by reflection from the cryodeposit surface with rays which are scattered by passage through the surface and specularly reflected by the substrate. A simple light scattering model for cryodeposits is proposed which allows accurate determination of the deposit thickness from the interference patterns. Application of the scattering theory required knowledge of the refractive index of the cryodeposit. Consequently, the index of refraction for CO2 cryodeposits was determined from separate Bragg interference tests at wavelengths from 0.6 to 1.0 micron. Cryodeposit thicknesses up

to 100 microns were determined from the scattering model equation. Utilizing mass conservation principles, the thickness calculations were further used to determine the mean cryodeposit density. A few scattering interference tests on other types of cryodeposits are also briefly reported. Author (TAB)

N68-15101# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ALL UNION SCIENTIFIC RESEARCH INSTITUTE OF METROLOGY. RESEARCH IN THE FIELD OF MAGNETIC MEASUREMENTS
6 Sep. 1967 76 p refs Transl. into ENGLISH from the Publ. "Vsesoyuznyy Nauchno-Issledovatel'skiy Institut Metrologii. Issledovaniya v Oblasti Magnitnykh Izmereniy" Moscow, no. 72, 1963 p 5–16, 53–100
(FTD-MT-65-408; AD-662248)

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N68-15102# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INTERNATIONAL SYSTEM OF UNITS IN THE PRACTICE OF MAGNETIC MEASUREMENTS [MEZHDUNARODNAYA SISTEMA EDINITS V PRAKTIKE MAGNITNYKH IZMERENIY]
Ye. N. Chechurina *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 1–15 refs (See N68-15101 06-23)

This article was written in connection with the introduction into the U.S.S.R. of the international system of units, in which the field of magnetic phenomena and measurements requires considerable interpretation and more precise definitions. Given in the article are factors for the transfer of values of different magnetic magnitudes from earlier applied systems into an absolute practical MKSA system with rational form of equations of the electromagnetic field corresponding in the field of electrical and magnetic magnitudes to the international system. Author

N68-15103# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
EXPANSION OF THE FREQUENCY LIMIT OF APPLICABILITY OF HIGH-FREQUENCY PERMEAMETERS [RASSHIRENIYE CHASTOTNOGO PREDELA PRIMENIMOSTI BYSOKOCHASTOTNYKH]
A. L. Grokhol'skiy and A. F. Kugayevskiy *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 17–26 refs (See N68-15101 06-23)

The method of measuring magnetic permeability and loss angle of ferromagnetic materials with the help of coaxial and compensational sample holders is examined. It is shown that with the help of the given measurement method it is possible to conduct tests of the magnetic permeability and angle of magnetic losses of materials at frequencies up to 200 MHz without resorting to the use of complicated and expensive equipment. Author

N68-15104# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INVESTIGATION OF APPARATUS FOR DETERMINING THE MAGNETIZATION CURVES OF TRANSFORMER STEEL IN WEAK FIELDS [ISSLEDOVANIYE APPARATA DLYA OPREDELENIYA KRIVOY NAMAGNICHIVANIYA ELEKTROTEKHNICHESKOY SLABYKH POLYAKH]
A. Z. Veksler and N. V. Pen'kov *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 27–42 refs (See N68-15101 06-23)

The determination of the magnetic characteristics of sheet transformer steel in weak magnetic fields is considered. The examination is conducted in reference to the standardization of tests on alternating currents. Author

N68-15105# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
A NEW HIGHLY SENSITIVE BALLISTIC METHOD OF TESTING FERROMAGNETIC MATERIALS [NOVYY VYSOKOCHUSVTVITEL'NYY BALLISTICHESKIY METOD ISPYTANIYA FERROMAGNITNIYKH MATERIALOV]
P. N. Goryunov *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 43–56 refs (See N68-15101 06-23)

A description is given of a new ballistic method of testing ferromagnetic materials with the usual ballistic galvanometer. The sensitivity can be increased more than 100 times as compared to the known ballistic method. The high sensitivity of the method permits using it in the testing of very small samples of material with low permeability, for which the density of magnetic flux can reach up to 0.1 microweber/m^2. Author

N68-15106# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
APPLICATION OF THE QUARTZ MAGNETOMETER FOR HELMHOLTZ COILS [PRIMENENIYE KVARTSEVOGO MAGNITOMETRA DLYA POVERKI KATUSHEK GEL'MGOL'TSA]
Yu. G. Mekhev *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 57–66 (See N68-15101 06-23)

A simple magnetometric method for determining the constant of Helmholtz is described. The advantage of this method over the usually applied ballistic method is that its accuracy is considerably higher and furthermore it is applicable for coils with very small constants and coils wound with very thin wire or having solid metallic frame. Author

N68-15107# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ELECTRONIC GAUSSMETER OF THE EG-1 TYPE, BASED ON THE USE OF THE HALL EFFECT [ELEKTRONNYY GAUSSMETR TIPA EG-1, OSNOVANNYY NA ISPOL'ZOVANII EFFEKTA KHOLLA]
V. F. Vitkovskiy and Ye. A. Sokolova *In its* All Union Sci. Res. Inst. of Metrology. Res. in the Field of Magnetic Meas. 6 Sep. 1967 p 67–75 refs (See N68-15101 06-23)

Work was carried out in connection with the development of new alloys for permanent magnets with great coercive force up to 400 kA/m. A description is given of the gaussmeter of the EG-1 type designed for the measurement of magnetic induction in a range from 0.01 to 2.0 Wb/m^2. Author

N68-15176# Aerospace Corp., El Segundo, Calif. Lab. Operations.
INTEGRAL-TRANSFORM FORMULATION OF DIFFRACTION THEORY
George C. Sherman Oct. 1967 36 p refs
(Contract F04695-67-C-0158)
(TR-0158(3230-25)-1; SAMSO-TR-67-101; AD-663231)

An exact integral-transform formulation of the theory of the diffraction of monochromatic scalar waves from an infinite plane boundary with known boundary values is developed from first principles. The formulation is analogous to the Fourier-transform formulation of Fraunhofer diffraction, except that it is exact and is valid for both Fresnel and Fraunhofer diffraction. The known wavefunction on the boundary is expanded into a linear superposition of point-convergence patterns. The point-convergence pattern is defined as the pattern of the wavefunction that must exist on the boundary in order to produce a Dirac delta-function distribution of the wavefunction on a plane of observation that is parallel to the boundary. This pattern is described by a point-convergence function h determined by the position of the delta-function singularity on the plane of observation and the distance of that plane from the boundary. The point-convergence function is orthogonal to a function g called the point-divergence function. Together g and h serve as kernels for a new integral transform called the diffraction transform. The pattern of the wavefunction on the plane of observation is the diffraction transform of the wavefunction on the boundary. We show that g represents the field of a dipole while h cannot be expressed by an ordinary function and must be defined as a functional. Successive diffraction transformations are discussed, and the transform formulation of Fraunhofer diffraction is obtained as a special case from the diffraction-transform theory. Author (TAB)

N68-15271# Institut Franco-Allemand de Recherches, St. Louis (France).
CALCULATION OF VELOCITIES OF METALLIC SPHERES SHOT AT HIGH VELOCITIES IN A REENTRY SIMULATOR FOR ABLATION STUDIES [CALCUL DES VITESSES DES SPHERES METALLIQUES LANCEES A GRANDE VITESSE DANS LE SIMULATEUR DE RENTREE ET DESTINEES AUS ETUDES D'ABLATION]
J. Lunesu 11 Jan. 1967 94 p refs In FRENCH
(ISL-T-1/67)

High velocity metal spheres travel in a reentry simulator either under normal pressure or against flow direction. All models ablate during part of the flight and their velocity curve is determined as abscissa function for each shot. The two coefficients for the curve are obtained by differential velocity equations for various flight paths points. Simulated flow velocity is considered in counterflow shots. Author

N68-15281 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE DERIVATION OF MODELS OF LIQUID MEDIA AND SOLID BODIES FROM THE KINETIC EQUATION OF THE AVERAGED FORCE FIELD [POLUCHENIYE IZ KINETICHESKOGO URAVNENIYA DLYA USREDNENNOGO POLYA SIL MODELEY ZHIDKIKH SRED I TVERDYKH TEL]
M. R. Korotkina *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 47–59 refs (See N68-15276 06-10)

By using the kinetic equation of the averaged force field the author has constructed the density of distribution of particles for liquids and solids. Author

N68-15283 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE ASYMPTOTIC THEORY OF RELAXATION OSCILLATIONS IN SYSTEMS WITH ONE DEGREE OF FREEDOM. 2: CALCULATION OF THE PERIOD OF THE LIMIT CYCLE [K ASIMPTOTICHESKOY TEORII RELAKSATSIONNYKH KOLEBANIY V SISTEMAKH S ODNOY STEPEN'YU SVOBODY 2. VYCHISLENIYE PERIODA PREDEL'NOGO TSIKLA]
N. Kh. Rozov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 65–74 refs (See N68-15276 06-10)

The author continues a previous study of relaxation (discontinuous) oscillations of autonomous systems of second order with a small positive parameter for one of the derivatives. The notation, definitions, and results of the previous paper are freely used. The author extends the method of computing a period to the case of a nonregular point of arbitrary order. He writes an asymptotic formula for the period of relaxation oscillations in the system when the curve Γ has points of discontinuity of arbitrary even order and points of disentanglement of arbitrary odd order. This approximate expression for the period is determined without integration, since all the constants in the formulas from which it is derived are either absolute or are determined directly from the right parts. Author

N68-15285 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ABOUT A CASE OF STABILITY OF TRANSIENT MOTION OF A TOP ON A PLANE [OB ODNOM SLUCHAYE USTOYCHIVOSTI NEUSTANOVIVSHEGOSYA DVIZHENIYA VOLCHKA NA PLOSKOSTI]
V. M. Morozov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 81–86 refs (See N68-15276 06-10)

The author studies the problem of motion of a heavy hard body resting on a spherical base on a fixed horizontal plane. Without going into the technical possibility of realizing such motion, he studies a simplified formulation of the problem in the case when slipping friction can be neglected and the moment of the forces of resistance, proportional to the vertical component of the angular velocity of the gyroscope, has an essential effect on the motion of the gyroscope. He gives the conditions for stability of perturbed motion in various cases. Author

N68-15435# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
STABILITY OF DISSIPATIVE SYSTEMS [K USTOYCHIVOSTI DISSIPATIVNYKH SISTEM]
S. Ya. Stepanov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 77–88 refs (See N68-15248 06-19)

Equations are derived for determining the stability of stationary motion of a dissipative system, in which the energy dissipation is compensated by the action of additional forces. In the approach taken, the direct method of Liapunov is applied to prove the theorems on the stability of the equilibrium of dissipative systems. Consideration is given to a conservative, holonomic, and scleronomic mechanical system determined by n independent generalized coordinates. It is assumed that the additional constant forces vary in the disturbed motion. M.G.J.

N68-15495# Army Cold Regions Research and Engineering Lab., Hanover, N. H.
SELF-DIFFUSION IN ICE MONOCRYSTALS
Oct. 1967 98 p refs
(RR-232; AD-662196)

The self-diffusion of tritium, parallel and perpendicular to the optical axis of naturally occurring and artificially grown ice monocrystals, was studied between -2.5 and -35.9C. The artificial ice monocrystals were grown using a zone-melting technique. Activated samples were stored for several weeks, then sectioned by microtome and analyzed in a liquid scintillation counter to obtain the self-diffusion coefficients. The plane source solution of Ficks second law was used in treating the data. The diffusion coefficients were found to be identical for both types of ice. A slight anisotropy was found due to the geometry of the crystal; however, the activation energy was found to be 0.62 eV for all cases. Based on the experimental data, it is concluded that the diffusion takes place by a vacancy mechanism and that entire H2O molecules are diffusing, i.e., molecular diffusion occurs. Theoretical calculations using the atomic diffusion theory and Zeners theory for the initial diffusion coefficient are in excellent agreement with the experimentally determined diffusion coefficient. Author (TAB)

N68-15549# Naval Civil Engineering Lab., Port Hueneme, Calif.
ACOUSTIC NOISE REDUCTION IN SHIELDED ENCLOSURES Final Technical Report, Jun.–Aug. 1965
H. A. Lasitter Nov. 1967 21 p refs
(TR-R-549; AD-662394)

The acoustic NR (noise reduction) for a shielded enclosure at NCEL has been determined. The instrumentation necessary for measuring NR in the frequency range between 100 and 15,000 Hz has been established. All measurements make use of an air-borne signal source which is capable of providing approximately 60 db dynamic range in signal-level measurement. A standard method and a swept-frequency method were used to measure NR. The two methods are compared in this report. The far-field and near-field NR values have been measured for a 20x20x10-foot shielded enclosure. The vibration level (measured with an accelerometer) at the walls of the enclosure have also been determined. The minimum noise-reduction (near-field) values were on the order of 10 db at 1,500 Hz. Far-field NR measurements yield values from 12 to 45 db from 100 to 10,000 Hz.
Author (TAB)

N68-15601# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LENINGRAD. UNIVERSITY. HERALD. MATHEMATICS, MECHANICS AND ASTRONOMY SERIES
5 Sep. 1967 221 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron (Leningrad), v. 19, no. 19, 1964 p 1–164
(FTD-MT-65-03; AD-662256)

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1. MINIMIZATION OF SMOOTH CONVEX FUNCTIONAL ON A CONVEX SET V. F. Dem'yanov and A. M. Rubinov p 3–19 refs (See N68-15602 06-19)

2. NECESSARY CONDITIONS OF STRONG STABILITY OF HAMILTON EQUATIONS WITH UNLIMITED PERIODIC OPERATIONAL COEFFICIENTS V. I. Derguzov p 21–38 refs (See N68-15603 06-19)

3. MOTION OF A SOLID PLANE IN VISCOUS LIQUID UNDER THE ACTION OF A LONGITUDINAL ELASTIC FORCE A. B. Ivanov p 39–52 refs (See N68-15604 06-12)

4. ROUGH INVESTIGATION OF OSCILLATIONS OF A QUASI-LINEAR SYSTEM WITH ONE DEGREE OF FREEDOM L. I. Kuznetsov p 53–64 refs (See N68-15605 06-23)

5. LATTICE EXPANSIONS OF INFINITELY DIVISIBLE LAWS I. V. Ostrovskiy p 67–79 refs (See N68-15606 06-19)

6. FIGURES OF EQUILIBRIUM OF A HOMOGENEOUS ROTATING LIQUID IN AN EXTERNAL FIELD M. G. Rabinovich p 81–96 refs (See N68-15607 06-12)

7. NORMS OF LINEAR POLYNOMIAL OPERATORS IN CONNECTION WITH PROBLEMS OF APPROXIMATION OF CONTINUOUS FUNCTIONS N. A. Sapogov p 97–102 refs (See N68-15608 06-19)

8. ONE PROPERTY OF A MEASURABLE FUNCTION G. Ya. Yarakhmedov p 103–112 refs (See N68-15609 06-19)

9. ASYMPTOTIC STRUCTURE OF A BOUNDARY LAYER FOR LARGE M R. G. Barantsev and Yu. Shiazha p 115–118 refs (See N68-15610 06-12)

10. LAMINAR BOUNDARY LAYER WITH CALCULATION OF RADIATION IN THE ABSENCE OF PRESSURE GRADIENT Z. S. Galanova p 119–132 refs (See N68-15611 06-33)

11. DAMPING OF SHOCK WAVES IN WATER A. A. Grib and N. S. Medvedev p 133–147 refs (See N68-15612 06-12)

12. EQUILIBRIUM STATISTICAL DISTRIBUTIONS FOR GASES, DIFFERENT FROM BOLTZMANN DISTRIBUTION S. V. Vallander, I. A. Yegorova, and M. A. Rydalevskaya p 149–153 refs (See N68-15613 06-12)

13. LAMINAR BOUNDARY LAYER OF GAS ON A FLAT PLATE WITH CALCULATION OF THERMODYNAMIC AND CHEMICAL NONEQUILIBRIUM L. A. Ladnova p 155–172 refs (See N68-15614 06-12)

14. ROTATIONAL MOTION OF A SPHERICAL SATELLITE UNDER THE ACTION OF RETARDING AERODYNAMIC MOMENTS N. T. Po p 173–180 refs (See N68-15615 06-01)

15. DETERMINATION OF DAMPING AERODYNAMIC MOMENT BY THE METHOD OF TWO-STAGE UNDAMPED OSCILLATIONS V. B. Petrushin p 181–193 ref (See N68-15616 06-01)

16. THE PROBLEM ABOUT VIBRATIONS OF BEAM IN A LIQUID P. Ye. Tovstik p 195–203 refs (See N68-15617 06-32)

17. DETERMINATION OF PHYSICAL PARAMETERS OF THE ATMOSPHERE OF THE SUN BY THE METHOD OF CURVES OF GROWTH D. M. Kuli-Zade p 207–220 refs (See N68-15618 06-30)

N68-15605# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ROUGH INVESTIGATION OF OSCILLATIONS OF A QUASI-LINEAR SYSTEM WITH ONE DEGREE OF FREEDOM [O PRIBLIZHENNOM ISSLEDOVANII KOLEBANIY KVAZILINEYNYKH SISTEM S ODNOY STEPEN'YU SVOBODY]
L. I. Kuznetsov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 53–64 refs (See N68-15601 06-23)

The Budnov–Galerkin method is applied to the study of oscillations of the quasi-linear systems with one degree of freedom. Sets of Jacobian equations and matrices used for solutions of the problem, are presented. L.S.

N68-15634# National Electrotechnical Inst., Turin (Italy).
ON THE MEASUREMENT OF SMALL DEVIATIONS FROM THE OHMIC LAW, PART B Final Scientific Report
Guido Bonfiglioli, Piero Brovetto, and Gianluigi Busca May 1967 22 p refs
(Grant AF-EOAR-66-27)
(AFOSR-67-2785; AD-662625)

The present note describes a setup for recording the second derivative of the current vs. voltage characteristic of a passive electric bipole. From such a record small deviations from linearity (i.e. Ohmic conduction) can be measured with very high sensitivity. The second derivative is obtained by measuring, with a lock-in

amplifier, the second harmonic content of the current through the bipole, when the latter is subjected to a sinusoidal voltage, accurately harmonic-free. The principle of the method is developed and the performance of the setup is demonstrated in a typical case. Author (TAB)

N68-15673# Atomic Weapons Research Establishment, Foulness (England).
ELECTRICAL BREAKDOWN IN VACUUM
W. D. Owen and M. H. Davies Nov. 1967 32 p refs
(AWRE-O-77/67) HMSO: 5s 6d

Consideration is given to the preliminary investigations of the effect of various conditioning processes on the pre-breakdown and breakdown voltage characteristics of molybdenum. Author

N68-15687# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
MOTION NEAR A PHASE BOUNDARY IN THE PRESENCE OF AN ELECTROMAGNETIC FIELD
U. I. Ivanov and Yu. A. Mikhaylov 24 Jul. 1967 22 p refs Transl. into ENGLISH from Izv. Akad. Nauk Latv. SSR, Ser. Fiz. i Tekhn. Nauk (Riga), no. 1, 1966 p 3–15
(FTD-HT-67-478; AD-663334)

An approximate mathematical model of a double-layer is given. The general characteristics of its structure are considered. On the basis of this model, equations of fluid motion near the fluid-fluid interface and the fluid-solid body interface are solved. The velocity of relative motion of contacting phases in the presence of electromagnetic field is given. The characteristics of fluid motion under the influence of electrical and magnetic fields near the interface are indicated. The physical nature of the term skidding plane is disclosed and the method of its calculation is presented. TAB

N68-15761# Technische Hochschule Hannover (West Germany).
ON THE INFLUENCE OF THE LOAD ON THE MAGNETIC NOISE OF SYNCHRONOUSH MACHINES WITH WHOLLY PERFORATED COILS [UEBER DEN EINFLUSS DER BELASTUNG AUF DEN MAGNETISCHEN LAERM VON SYNCHRONMASCHINEN MIT GANZLOCHWICKLUNGEN]
Michael Weis (Ph.D. Thesis) 1966 79 p refs In GERMAN

A method for calculating the magnetic noise of synchronous machines is given, taking into account the air gap fields, radial force waves, radial deformations of the stator package, and radial deformations of the housing. Noise levels at the surface of the housing are calculated, and the results of measurements performed on three different hydroelectric generators are compared with predicted values. Transl. by K.W.

N68-15830# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERAMIC SOUND RECEIVERS
A. A. Anan'yeva 4 May 1967 174 p refs Transl. into ENGLISH of the book "Keramicheskiye Priyemniki Zvuka" Moscow, Izd. An SSSR, 1963 p 1–178
(FTD-MT-65-455; AD-662398)

Contents: Dielectric and piezoelectric properties of ceramics of barium titanate; Methods of the determination of characteristics of sound receivers; Nondirectional broad-band sound receivers; Broad-band sound receiver with flat receiving diaphragms; Spectra of natural frequencies of piezoceramic spherical and cylindrical; Resonance sound receivers with ceramic piezoelectric elements. TAB

N68-15870* Kaman Aircraft Corp., Colorado Springs, Colo.
COMPARISON OF TWO METHODS FOR ESTIMATING SOUND INTENSITY
Jan. 1968 186 p
(Contract NAS8-11348)
(NASA-CR-61187) CFSTI: $3.00 CSCL 20A

Obtained by ray-tracing methods, the diagnosed strength of noise fields depends partly on just the way in which the observed atmosphere is to be represented. Along the local vertical, a linearized variation of horizontal wind- and sound-speed introduces certain characteristics in the outward ranging of sound and its intensity. Such a straight-stepped representation of aerological data has been customary in meteorological practice, as a convenient approximation of the smoothly changing atmosphere. Descriptive of the real atmosphere, a non-linear representation of the aerological observations is nevertheless easily obtained. These representations lead to two methods for estimating sound intensity. This report discusses these methods and compares the results obtained by them. Author

N68-15880# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE DEFECT INDICES OF LINEAR OPERATIONS IN BANACH SPACE AND ON SOME GEOMETRIC QUESTIONS
M. G. Krein, M. A. Krasnosel'skii, and D. P. Milman 10 Aug. 1967 30 p refs Transl. into ENGLISH from Sb. Tr. Inst. Mat. Akad. Nauk UKRSSR (Ukrania), no. 11, 1948 p 97–112
(Contract NOw-62-0604-c)
(TG-230-T530; AD-663073)

The authors show that the theory of defect indices of Hermitian operators in a Hilbert space can be extended to the case of linear operators in a Banach space. For this purpose they use the idea of aperture (gap) of two sub-spaces with whose help it is convenient to establish in many cases the equality of the dimensions of the subspaces of the Banach space. The authors also arrive at several geometric conjectures. TAB

N68-15881# Yale Univ., New Haven, Conn.
DIFFUSION: A RELATIVISTIC APPRAISAL
Don Kelly [1967] 17 p refs
(Contract Nonr-609(51))
(AD-662908)

The classic equation describing diffusion is not consistent with the principles of special relativity. Specifically, its solutions permit the diffusive flow of particles to proceed at speeds in excess of the speed of light. A careful derivation, proceeding from the covariant form of the Boltzmann equation, results in a diffusion equation which exhibits the correct causal behavior. This equation assumes a particularly simple form, known otherwise as the telegraphers equation -- when the collision frequency for momentum transfer is independent of particle speed. The general solution for diffusion in one dimension is presented, revealing the causal character of the diffusive flow. Author (TAB)

N68-15905*# National Aeronautics and Space Administration. Electronics Research Center, Cambridge, Mass.
HOLOGRAPHIC DISPLAY SYSTEMS
A. J. Devaney, C. Grauling, and S. Baron *In its* 3d Ann. NASA Univ. Conf. on Manual Control 1967 p 55–65 refs (See N68-15901 06-05)

Recent advances in the field of holography, particularly in the development of techniques for making high-quality holograms, have raised the possibility of using holograms for flight displays or flight simulators. Holograms possess many characteristics, such as

the three-dimensional image formation property and variable perspective, which make them particularly attractive for display or simulation purposes. This is especially true when one wishes to display real scene information since the reconstructed hologram contains almost all the information in the original scene. A hologram, however, stores a static scene. Thus, if a dynamic display is required, as would be the case if the observer is moving relative to the scene, one is confronted with the possibility that a great many holograms, corresponding to various viewing positions, may have to be stored. A alternative approach would be to manipulate the virtual image resulting from a single hologram in a manner related to changes in viewing aspect and position of the observer. This latter approach for obtaining a dynamic holographic display is the major topic of this paper. In particular, techniques for obtaining six degrees of viewing freedom are developed, using fundamental concepts of optics and holography. These techniques make it possible to display the visual effect of arbitrary motion of the observer relative to the scene using one, or possibly a few, stored holograms. Some of the current state-of-the-art difficulties associated with holographic display systems are also discussed, and areas for future development are indicated. Author

N68-15950*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SUBCRITICAL CRYOGENIC STORAGE DEVELOPMENT AND FLIGHT TEST

R. K. Allgeier Washington Feb. 1968 92 p refs

(NASA-TN-D-4293) CFSTI: HC$3.00/MF$0.65 CSCL 20M

A subcritical cryogenic nitrogen system was aboard Apollo-Saturn flight 203 on July 5, 1966. This flight completed development of this particular sub-critical system. This paper contains the development history, ground-test results, and flight-test results of a sub-critical cryogenic storage system which is designed to supply warm vapor regardless of the liquid orientation. A two-phase development program resulted in delivery of ground-test units and flight units. The successful flight test culminated development efforts with this subcritical system and demonstrated its feasibility. Author

N68-16026 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

LENINGRAD. UNIVERSITY. HERALD. MATHEMATICS, MECHANICS AND ASTRONOMY SERIES

17 Apr. 1967 243 p refs Transl. into ENGLISH from Vestn. Leningr. Univ., Ser. Mat., Mekh. i Astron. (Leningrad), v. 19, no. 13, 1964 p 1–168

(FTD-MT-65-02; AD-662522)

A collection of Soviet articles are presented on mathematics, mechanics, and astronomy. For individual titles, see N68-16027 through N68-16046.

N68-16039 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

A POINT SOURCE IN A SEMI-INFINITE MEDIUM BOUNDED BY A REFLECTIVE SURFACE [TOCHECHNYY ISTOCHNIK V POLUBESKOVECHNOY SREDE ORGANICHENNOY OTRAZHAYUSHCHEY POVERKHNOST'YU]

A. K. Kolesov and D. I. Naginer *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 151–160 refs (See N68-16026 06-23)

The problem of light scattering in a simi-infinite homogeneous medium within which the point source of radiation is placed is considered. It is assumed that the medium is bounded by an isotropic or direct surface from above. The source function and the intensity of radiation are found approximately with an arbitrary indicatrix of scattering. Author

N68-16040 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

APPLICATION OF METHODS OF ANALYTIC DYNAMICS IN THE THEORY OF OPTIMAL TRANSFERS [PRIMENENIYE METODOV ANALITICHESKOY DINAMIKI V TEORII OPTIMAL'NYKH POLETSV]

V. S. Novoselov *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 161–178 refs (See N68-16026 06-23)

The methods of analytic mechanics are applied to the study of problems in the theory of optimum processes. Under the assumptions that the behavior of the control plant is described by a system of ordinary differential equations and that the control functions are constrained by certain inequalities, the problem of optimal control is defined as the selection from the set of allowable control functions of a control function such that the system is taken from the initial state to the terminal state in a finite time and a certain performance functional (functional of action) is minimized. The possibility of determining the optimum control by the Hamilton–Jacobi method is indicated. The problem is reduced to the solution of a Hamilton–Jacobi equation, which in this case is a linear, first-order partial differential equation. As an example of the application of the Hamilton–Jacobi method, the optimal impulse transfers between two elliptic coplanar orbits in the gravitational field of a symmetric central body are considered. Author

N68-16067# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.

APOCHROMATIZATION AND TRIGONOMETRIC CALCULATION OF THE RAY PATH IN CHERENKOV COUNTERS [APOKHROMATIZATSIYA I TRIGONOMETRICHESKII RASCHET KHODA LUCHEI V SCHETCHIKAKH CHERENKOVA]

V. P. Zrelov, P. Paviovic, and P. Sulek 1967 51 p refs In RUSSIAN

(JINR-P13-3488)

A method of calculation of an apochromatic system consisting of two axial prisms is considered. Such a system makes it possible to extract Vavilov–Cherenkov radiation with three different wave-lengths under the same chosen angle in differential Cherenkov counters. Formulas are given making it possible to calculate trigonometrically the path of an arbitrary ray of the Vavilov–Cherenkov radiation cone in Cherenkov counters, the optical system of which consists of a radiator, a double axial prism and a spherical mirror. Algorithms for all the computations written in Algol 60 are contained in the appendices. Author (NSA)

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N68-15038# Kernforschungsanlage, Juelich (West Germany). Zentralinstitut fuer Reaktorexperimente.

ACTIVATION RESONANCE INTEGER AND NEUTRON SELF-SHIELDING FACTOR [AKTIVIERUNGS-RESONANZINTEGRAL UND NEUTRONENSELBSTABSCHIRMFAKTOR]

G. Borchardt Sep. 1967 35 p refs In GERMAN

(JUL-503-RX)

The activation resonance integer and the neutron self-shielding factor in various nuclides were determined by irradiating metal foils with and without a cadmium layer in order to differentiate between thermal and epithermal neutrons. Experimental and calculated results for gold[197], tungsten[186], arsenic[75], manganese[55], copper[63], and sodium[23] were obtained and agreed with elsewhere established values. Transl. by G.G.

N68-15049 Technische Hochschule Hannover (West Germany).
A METHOD FOR MEASURING THE EXPANSION FACTORS FOR GAMMA RAYS IN THE ENERGY RANGE OF 0.5–15 MeV [EINE METHODE ZUR MESSUNG DER ZUWACHSFAKTOREN FUER GAMMASTRAHLEN IM ENERGIEBEREICH VON 0,5–15 MeV]
Werner Futtermenger (Ph.D. Thesis) [1966] 101 p refs In GERMAN

An electron accelerator for bremsstrahlung and a sensitive sodium iodide crystal detector are used to measure gamma ray energies in the 0.5 to 15 MeV range. Separated measurements on spectrum center, and side scattering fields of a narrow gamma ray beam are evaluated for their expansion factor from the energy absorption characteristics in iron shielding and concrete layers. Transl. by G.G.

N68-15111# Lincoln Lab., Mass. Inst. of Tech., Lexington.
TABLES OF HEMISPHERE SCATTERING AMPLITUDE FOR NOSE-ON INCIDENCE
Stephen D. Weiner 29 Nov. 1967 22 p refs
(Contract AF 19(628)-5167; ARPA Order 498; Proj. Defender)
(TN-1967-54; EDS-TR-67-567; AD-662866)

Tables of the electromagnetic scattering amplitude and cross section of a conducting hemisphere for nose-on incidence are presented as a function of frequency, bistatic angle and polarization. The tables give the real and imaginary parts of the scattering amplitude and the radar cross section normalized to pi R sq (R = hemisphere radius). Results are shown for kR (k = 2 pi/wavelength) from 0.2 to 20.0 in steps of 0.2, for bistatic angles from 0 degrees to 150 degrees in steps of 30 degrees and for both HH and VV polarizations. Author (TAB)

N68-15114 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
A COVARIANT THEORY OF THE PIONIC DISINTEGRATION OF THE DEUTERON 1
Dominique Schiff and J. Tran Thanh Van Nov. 1967 59 p refs
(TH/225)

The pionic disintegration of the deuteron and its inverse process are studied in a covariant theory from threshold to 300 MeV pion kinetic energy. The singularity structure of the scattering amplitude as found from box diagrams makes it possible to select the leading contributions that come from the nucleon pole, the deuteron structure and the N N and N N π intermediate states. The latter is treated as an N N* state where N* is the (3,3) pion nucleon resonance. Dispersion relations are written for partial wave amplitudes and the contribution of the N N* state to unitarity is explicitly calculated, taking into account the spin and the unstability of N*. A detailed comparison in the medium energy region shows a good agreement with the existing data. Author

N68-15121# United Kingdom Atomic Energy Authority, Harwell (England). Information Branch.
THE GENERAL QUANTUM THEORY OF COLLISION PROCESSES
W. Brenig and R. Haag Jan. 1967 77 p refs Transl. into ENGLISH from Fortschr. Physik (Berlin), v. 7, 1959 p 183–242
(AERE-TRANS-1066) HMSO: 10s

Collision processes between particles of a single compact physical system are described. A scattering theory model is formulated based on an equation in which the Hamilton operator equals kinetic energy of unperturbed motion of isolated particles plus energy of interaction between particles. These relationships are regarded as an algorithm to define and determine an S matrix. The information given by S concerning the space and time dependence of processes and resultant qualitative restrictions on S are also determined. In considering the behavior of cross-sections in the neighborhood of resonances and low energy thresholds, the S matrix is presented by simplified expressions. Analytical properties of the S matrix in complex plane are given, along with the analytical properties of the forward scattering amplitude. B.S.D.

N68-15163# Yale Univ., New Haven, Conn.
CYCLOTRON RESONANCE AGAIN
Henry Margenau 1967 5 p
(Contract Nonr-609(51))
(AD-662911)

The report concerns the determination of the width of the cyclotron resonance line by the methods usually employed in calculations on pressure broadening of spectral lines. TAB

N68-15182# Centro Brasileiro de Pesquisas Fisicas, Rio de Janeiro.
MODEL FOR LOW ENERGY KAON NUCLEON SCATTERING
Erasmo M. Ferreira and Robert Lacaze 1967 10 p refs *In* Notas de Fisica, Vol. 13, No. 6

The algebra of currents together with the hypothesis of partially conserved axial current predict for the meson–nucleon scattering lengths values which are in good agreement with experimental results. Others have shown that, with a model based on an effective Lagrangian satisfying to lowest order the conditions of algebra of currents and PCAC, it is possible to obtain, for the pion-nucleon low energy parameters, values which are in very good agreement with the available experimental data. A similar model, describing low energy K–N scattering, is built and tested. Author

N68-15184# University Coll., London (England). Dept. of Physics.
RESEARCH REPORT OF THE DEPARTMENT OF PHYSICS, 1965–1966
[1967] 82 p refs CFSTI: HC $3.00/MF $0.65

An account of the activities of the different research groups for atomic physics, high energy atomic collisions, ionic and electronic physics, and theoretical physics as well as of the Mullard Space Science Lab. engaged in the space physics programs is given, covering the session 1965–1966. ESRO

N68-15238# Yale Univ., New Haven, Conn. Electron Accelerator Lab.
THE CALCULATION OF INELASTIC ELECTRON SCATTERING BY NUCLEI
James F. Ziegler May 1967 294 p refs
(Contract AT(30-1)-2726)
(YALE-2726E-49) CFSTI: HC $3.00/MF $0.65

The computer program GBROW, with which electron inelastic scattering can be treated using any phenomenological model of the nucleus or nuclear wave functions, is described. The theoretical formulation is outlined. NSA

N68-15328*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EXCITED STATES OF XENON 128

Glenn M. Julian, S. Jha (Western Reserve Univ.), and A. S. Johnston (Carnegie Inst. of Tech.) Washington Feb. 1968 19 p refs Submitted for publication

(NASA-TN-D-4305) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Gamma rays accompanying the decay of 25 minute iodine 128 (^{128}I) and 3 minute cesium 128 (^{128}Cs) have been studied with 8- and 30-cubic centimeter lithium-drifted germanium spectrometers. Coincidences between gamma rays were studied using two 7.6 by 7.6 centimeter thallium-activated sodium iodide scintillators. A level scheme of Xenon 128 (^{128}Xe) has been constructed with levels at 443.2 (2^+), 969.6 (2^+), 1583.1 (0^+, 1^+, 2^+), 2275.2, 2484.3, 2600.5, 2841.1, and 2862.8 keV. According to the hydrodynamical model, the near-spherical even-even nucleus ^{128}Xe could be expected to have a close-lying 0^+-2^+-4^+ "vibrational triplet" at about twice the energy of the first excited state. Population of the 0^+ and 2^+ members of such a triplet would be allowed in the decay of 1^+ ^{128}I and 1^+ ^{128}Cs. A 2^+ level of ^{128}Xe at about twice the energy of the first excited state had been found in previous investigations. In the present study a search was made for the predicted 0^+ triplet member. No evidence has been found for the existence of such a level. Author

N68-15367* Oak Ridge National Lab., Tenn.

THE ELECTRON–PHOTON CASCADE INDUCED IN LEAD BY PHOTONS IN THE ENERGY RANGE 15 TO 100 MeV

R. G. Alsmiller, Jr. and H. S. Moran Jan. 1968 33 p refs

(NASA Order R-104(1); W-7405-ENG-26)

(NASA-CR-92578; ORNL-4192) CFSTI: $3.00 CSCL 20H

Electron–photon cascade calculations have been carried out for photons of energy 15, 25, 35, 45, 60, and 75 MeV incident on a semi-infinite slab of lead of 3 radiation lengths' thickness and for photons of energy 100 MeV incident on a slab of lead of 15 radiation lengths' thickness. The results obtained include the energy deposition as a function of depth in the slab and the energy and angular distributions of the transmitted photons and charged particles. Author

N68-15512*# Scripta Technica, Inc., Washington, D. C.

ON THE INTERACTION OF ATOMS WITH THE SURFACE OF A SOLID [O VZAIMODEYSTVII ATOMOV S POVERKHNOST'YU TVERDOGO TELA]

Yu. A. Ryzhov and D. S. Strizhenov NASA Jan. 1968 9 p refs Transl. into ENGLISH from Zh. Prikl. Mekhan. i Tekhan. Fiz. (USSR) no. 4, Jul.–Aug. 1967 p 113–117

(Contract NASw-1694)

(NASA-TT-F-11470) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Computer studies are made of the interaction of atoms with a solid body at energies on the order of 10 eV. The procedure is based on the simultaneous solution of the system of classical equations of motion of the atoms (which form the solid body) and the bombarding particle for a given pair-interaction law. A system of dimensionless parameters characterizing such interaction processes is obtained, and typical results of the processes (such as reflection, adsorption, and absorption by the lattice of the incident particle) are demonstrated. The interaction of an atom with an ideal crystal with an Einstein lattice is examined for various parameters and lattice types. Estimates are obtained of the effect of the type of interaction law on the statistically averaged interaction characteristics (energy accommodation coefficient). A method for averaging the interaction process of atoms with an atomically smooth polycrystalline surface is given. Author

N68-15624# Naval Ordnance Lab., White Oak, Md.

ON THE HYPERFINE INTERACTION AND ZEEMAN EFFECT IN ATOMIC HYDROGEN $NS_{1/2}$, $NP_{1/2}$, AND $NP_{3/2}$ STATES

Jack Finkel 25 Aug. 1967 17 p refs

(NOLTR-67-131; AD-662678)

The eigenvalues and eigenfunctions of atomic hydrogen in the NS sub 1/2 and NP sub 1/2 states in Zeeman Effect taking account of hyperfine interactions are presented as generalizations of earlier work on 1S sub 1/2 and 2P sub 1/2 states. The eigenvalues and eigenfunctions of the NP sub 3/2 states are derived from the hamiltonian. Author (TAB)

N68-15638*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

A SEARCH FOR UNBOUND HELIUM 3 LEVELS WITH ISOBARIC SPIN 1/2

Robert E. Warner (Oberlin Coll.), John S. Vincent, and Edmund T. Boschitz Washington Feb. 1968 14 p refs

(NASA-TN-D-4377) CFSTI: HC $3.00/MF $0.65 CSCL 20H

An attempt was made to excite the unbound T = 1/2 states in helium 3 by (α–He^3) inelastic scattering. No states in He^3 between 3- and 13-MeV excitation were found. The shape of the inelastic alpha particle spectrum was calculated with the assumption that phase space alone determines the shape. Precise fits to the observed spectra were not obtained, but the similarity between calculated and observed spectra gave evidence that a broad maximum in the 17.5° spectrum was caused by phase space rather than a level in He^3. Other calculations with Baldin's formalism showed that no enhancement of the inelastic cross section near 8-MeV excitation in He^3 should be expected. Author

N68-15642 California Univ., Livermore. Lawrence Radiation Lab.

APPLICATION OF CHARGE INDEPENDENCE TO NEUTRON INELASTIC SCATTERING

John D. Anderson, Calvin Wong, and Victor A. Madsen (Oregon State Univ.) 27 Feb. 1967 11 p refs

(UCRL-50197) CFSTI: HC $3.00/MF $0.65

For several light nuclei such as ^{6}Li, ^{10}B and ^{14}N there exists a simple relation between (n,n'), (n,p), (p,n), and (p,p') cross sections for analog reactions. The derivation of this relation is briefly discussed and the basic assumptions are noted. As a practical example, ^{14}N is considered and (n,n') cross sections are obtained from the application of these relations. Author (NSA)

N68-15721*# Volt Technical Corp., Washington, D. C.

THRESHOLD BEHAVIOR OF IONIZATION CROSS SECTIONS

I. Zh. Vinkaln and M. K. Gaylitis 23 Jan. 1968 19 p refs Transl. into ENGLISH from Rasseyaniye Elektronov na Atomakh (Riga), 1967 p 17–34

(Contract NAS5-12487)

(NASA-CR-92533; ST-AC-PF-10665) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Angular and energy distributions are investigated by Wannier's method for electrons escaping after ionization. Wannier's theory is discussed, and the process of single ionization at energies close to threshold is reviewed. A numerical integration of the differential equations of motion was used to determine energy distribution of escaping electrons; and details are included for the complementary angle as well as the energy distribution of electrons after ionization. M.W.R.

N68-15791# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DIFFUSION PROCESSES INFLUENCED BY CONJUGATE POINT WAVE PHENOMENA
John M. Cornwall Sep. 1967 22 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-01)-1; SAMSO-TR-67-67; AD-662579)

Radial diffusion coefficients for low-energy protons in the magnetosphere are estimated for processes involving Pc 1, 2, and 3 hydromagnetic waves. These diffusion coefficients are compared to rough estimates of diffusion due to magnetic impulses and bays; this comparison gives an overall diffusion rate. An effective loss rate for pitch-angle diffusion (caused by Pc 1) is developed and combined with radial diffusion to yield a non-linear differential equation. Some estimates of expected proton flux levels are made on the basis of this equation. Author (TAB)

N68-15801 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1967 CERN SCHOOL OF PHYSICS. VOLUME 4
10 Nov. 1967 79 p refs Proc. held at Raettvik, Sweden, 21 May–3 Jun. 1967
(CERN-67-24, V. 4)

CONTENTS:

1. BEAM OPTICS K. G. Steffen (Deut. Elektron.-Synchrotron) 14 p refs (See N68-15802 06-24)

2. K° DECAY M. Vivargent (ESRO) 36 p refs (See N68-N68-15803 06-24)

3. POLARIZED TARGETS IN PARTICLE PHYSICS M. Jacob (Comm. a l'Energie Atomique) 18 p refs (See N68-15804 06-24)

N68-15802 Deutsches Elektronen-Synchrotron, Hamburg (West Germany).
BEAM OPTICS
K. G. Steffen *In* CERN Proc. of the 1967 CERN School of Phys., Vol. 4 10 Nov. 1967 14 p refs (See N68-15801 06-24)

Trajectory optics, magnet requirements for precision optics, composite spectrometers, envelope optics, and fundamentals of beam shaping systems were discussed in a lecture on beam optics as a tool for precision experiments. General trajectory equations in Cartesian coordinates are given; and field expansion with symmetry plane and linear trajectory equations are shown for a curved coordinate system. Consideration is also given to quadrupole transformation, sector magnet transformation, synchrotron magnet transformation, and the linear transformation of a general magnet in terms of effective magnetic length and strength. Various approximations are included, principal trajectories and focal properties are described, and nondispersive deflecting and isochronous systems are considered. Second order chromatic aberrations are discussed, as is sextupole transformation. Details are given for a sloped window spectrometer and mention is made of an image and other spectrometers. Liouville's theorem, magnet acceptance area, and beam envelope formalism are considered; and emittance, momentum, and mass filters are described. M.W.R.

N68-15803 European Organization for Nuclear Research, Geneva (Switzerland). Nuclear Physics Div.
K DECAY
M. Vivargent *In its* Proc. of the 1967 CERN School of Phys., Vol. 4 10 Nov. 1967 36 p refs (See N68-15801 06-24)

Theoretical aspects of the K^0–$\bar{K}^0$ system are reviewed, and the violation of CP and T as well as the validity of selection rules are considered. Lifetimes and mass differences of K_1^0 and K_2^0 are noted; and regeneration methods, including strangeness oscillation, are discussed. Interference effects between pion decays from K_2^0 and regenerated K_1^0 are described. Both leptonic and nonleptonic decays are discussed in relation to CP and T violation in kaon decays; and it is noted that there is no strong evidence for CP violation in leptonic decays. M.W.R.

N68-15804 Commissariat a l'Energie Atomique, Saclay (France). Service de Physique Theorique.
POLARIZED TARGETS IN PARTICLE PHYSICS
Maurice Jacob *In* CERN Proc. of the 1967 CERN School of Phys., Vol. 4 10 Nov. 1967 18 p refs (See N68-15801 06-24)

Spin effects are considered in relation to the theoretical analysis of elementary particle reactions, and it is shown how polarized proton targets may be used to analyze high energy scattering or production. Definition and determination of spin amplitudes are included, as is pion–nucleon scattering. The use of polarized targets to test time reversal invariance problems is considered. M.W.R.

N68-15851 European Organization for Nuclear Research, Geneva (Switzerland).
PROCEEDINGS OF THE 1967 CERN SCHOOL OF PHYSICS. VOLUME 3
15 Sep. 1967 182 p refs Conf. held at Rattvik (Sweden), 21 May–3 Jun. 1967
(CERN-67-24, V. 3)

CONTENTS:

1. QUANTUM NUMBERS OF BOSON RESONANCES G. Goldhaber (Calif. Univ., Berkeley) 95 p refs (See N68-15852 06-24)

2. TOPICS IN BARYON RESONANCES G. Giacomelli (Bologna Univ.) 57 p refs (See N68-15853 06-24)

N68-15852 California Univ., Berkeley. Lawrence Radiation Lab. Dept. of Physics.
QUANTUM NUMBERS OF BOSON RESONANCES
Gerson Goldhaber Jul. 1967 *In* CERN Proc. of the 1967 CERN School of Phys., Vol. 3 15 Sep. 1967 95 p refs Sponsored by AEC (See N68-15851 06-24)

Four lectures are presented dealing with quantum numbers of boson resonances. Established boson nonets are discussed, and hints of other boson nonets are included. Boson L clusters are reviewed, and the search for positive strangeness baryons is described. Appendixes to these lectures consider three-pion resonances, and tables of allowed and forbidden resonances of two-body decay modes are presented. M.W.R.

N68-15853 Bologna Univ. (Italy).
TOPICS IN BARYON RESONANCES
G. Giacomelli *In* CERN Proc. of the 1967 CERN School of Phys., Vol. 3 15 Sep. 1967 57 p refs (See N68-15851 06-24)

Formation and production experiments are considered in relation to baryon resonances, and the systematics of baryon resonances are discussed. Formation experiments deal with total and elastic cross sections as well as some inelastic channels. Production by both pions and kaons is considered; and nucleon resonances, hyperon resonances with $S = -1$ and -2, and the KN system are described. M.W.R.

N68-15871*# Maryland Univ., College Park. Inst. for Fluid Dynamics and Applied Mathematics.

RELATIVE RESONANCE LINE STRENGTHS IN THE NEON 1 AND ARGON 1 ISOELECTRONIC SEQUENCES

P. W. Murphy Dec. 1967 17 p refs

(Grant NsG-359)

(NASA-CR-92577; BN-522) CFSTI: HC $3.00/MF $0.65 CSCL 20H

We have calculated relative line strengths for the resonance lines of ions in the Neon I isoelectronic sequence through Iron XVII, and in the Argon I sequence through Iron IX. We used intermediate coupling theory, and evaluated the necessary parameters using observed energy levels. The relative line strength results for the Neon I sequence agree well with previous calculations using Hartree–Fock wavefunctions. For Iron IX, whose resonance lines are observed in the solar UV spectrum, we calculated absolute line strengths, oscillator strengths, and transition probabilities using the scaled Thomas–Fermi potential to obtain the radial transition integral. The transition probabilities obtained are: λ103.58, $A = 4.6 \times 10^{10}$ sec^{-1}, λ 105.24, $A = 2.7 \times 10^{10}$ sec^{-1}. Author

N68-15877*# Volt Technical Corp., Washington, D. C.

RADIATION DIFFUSION IN A MEDIUM WITH A STRONGLY ELONGATED SCATTERING INDICATRIX [DIFFUZIYA IZLUCHENIYA PRI SIL'NO VYTYANUTOY INDIKATRISE RASSEYANIYA]

V. V. Sobolev 26 Jan. 1968 6 p refs Transl. into ENGLISH from Dok. Akad. Nauk SSSR Astron. (Moscow), v. 177, no. 4, 1967 p 812–815

(Contract NAS5-12487)

(NASA-CR-92547; ST-OA-AA-10668) CFSTI: HC $3.00/MF $0.65 CSCL 20H

It is usually postulated in the theory of diffusion that the scattering indicatrix is spherical, or little differing from it. With such a postulate the working out of theory achieved to date a considerable success. However, the problem of radiation diffusion in a medium with a strongly elongated scattering indicatrix has been studied to a considerably lesser degree. Meantime such media are quite often encountered in practice. Related to them in particular are galactic dust nebulae, planetary atmospheres and water basins. An approximate method is proposed in the present note for the solution of the indicated problem, which consists in the reduction of the integral–differential equation for radiation transfer to a differential equation of second order in partial derivatives. The results obtained are applied to the case of Henyey–Greenstein's scattering indicatrix, and it is anticipated that similar results will be obtained in the case of other problems. Author

N68-15885# Aktiebolaget Atomenergi, Stockholm (Sweden).

LEVELS AND TRANSITION RATES IN ^{199}Au

A. Backlin (Uppsala Univ., Sweden), B. Fogelberg (Uppsala Univ., Sweden), and S. G. Malmskog (AB Atomenergi, Studsvik, Nykoeping, Sweden) 1967 48 p refs

(AE-300)

The decay of ^{199}Pt to ^{199}Au ($T_{1/2}$=30.8 min) has been investigated using a Ge(Li) detector and a double focusing beta spectrometer. Thirty-four transitions were found and multipolarities were assigned for 11 of these, including a 55.15 keV M2 +(0.9 $\pm$0.5)% E3 isomeric transition. Using these data together with the results of γ-γ and β-γ coincidence measurements, a decay scheme containing 9 excited levels and 25 transitions was constructed and spin and parity assignments were made. Using the delayed coincidence technique half-lives were determined for 3 levels and upper limits were obtained for 5 additional levels. The decay properties of the lowest excited positive parity levels are discussed in terms of de-Shalit's core excitation model. Author

N68-15887# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Neutronenphysik.

AVERAGE NUMBER AND ENERGY OF GAMMA-RAYS EMITTED AS A FUNCTION OF FRAGMENT MASS IN U^{235} THERMAL-NEUTRON-INDUCED FISSION

H. Maier-Leibnitz, H. W. Schmitt, and P. Armbruster Repr. from Phys. Chem. Fission, v. 2, 1965 p 143–161 refs Sponsored by AEC

(JUL-331-NP)

The average number and energy of gamma rays emitted as a function of fragment mass in U^{235} thermal neutron induced fission have been measured. A three parameter correlation experiment was performed in which two silicon surface barrier detectors were used to measure the fission product energies, and a 5-in-diam., 4-in-thick NaI(T1) scintillation crystal was used to measure the gamma ray energies. Extreme care was taken in the experimental arrangement to avoid counting direct fission neutrons, scattered gamma rays and neutrons, and other false events. Data were recorded event-by-event in a system similar to that used in previous energy correlation experiments, and were analysed according to a "weighting method" proposed by Maier–Leibnitz. The total number and energy of the gamma rays for both fragments as a function of mass ratio were obtained directly. The number and energy of gamma rays for individual fragment masses were determined by making use of the variation in laboratory angular distribution and energy of the gamma rays emitted from moving fragments. In particular, the 0° to 180° ratio of the number of gamma rays from a moving source emitting isotropically in its centre-of-mass system is proportion to $1+2\times2v/c$; similarly the 0° to 180° ratio in total gamma energy is proportional to $1+2\times3v/c$. Thus by comparing appropriate ratios in the analysis for light and heavy fragments moving towards or away from the gamma ray detector, one obtains these quantities as a function of individual fragment mass. Author

N68-15952# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ADIABATIC APPROXIMATION IN THEORY OF COLLISIONS [ADIABATICHESKOY PRIBLIZHENIYE V TEORII STOLKNOVENIY]

G. V. Dubrovskiy *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 3–9 refs (See N68-15951 06-06)

Inelastic processes in slow collisions of heavy particles are usually described by adiabatic approximation. In a previous work the author found the function characteristic of the probability of transitions for the case of two levels. In the present work, the fundamental matrix and the general solution of the vector equation for the interaction of h levels is constructed. The probabilities for nonadiabatic transitions are obtained from the phase integral method. The results are illustrated for the case of two pseudocrossing levels. Author

N68-15953# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

SATURATION OF ABSORPTION IN VIBRATION SPECTRUM. DISPERSION OF SATURATION [NASYSCHENIYE POGLOSCHENIYA V KOLEBATEL'NOM SPEKTRE DISPERSIYA NASYSHCHENIYA]

O. I. L'vov *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 11–26 refs (See N68-15951 06-06)

The saturation of absorption of the pumped frequency with the increase of the intensity in the lasers is caused by the equalization of the population of the energy levels under consideration. For the theoretical treatment of this phenomenon, the author considers a system of anharmonic oscillators in an electromagnetic field, and computes the behavior of the system by the perturbed density matrix method. The saturation of absorption

depends on the relations between the incident radiation density and the lifetime of the excited states. The saturation factor as a function of monochromatic radiation frequency is derived for a certain relationship between the line width and the anharmonic term shift. Author

N68-15954# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
SOLUTION OF EQUATIONS OF SELF-CONSISTENT FIELD FOR ATOMS ON BESM-2M [RASCHETYE URAVENIY SAMOSOGLASOVANNOGO POLYA DLYA ATOMOV NA BESM-2M]
V. F. Brattsev *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 27–35 refs (See N68-15951 06-06)

A method is given for computing the self-consistent field equations on a BESM-2M computer. Ground and some excited states of light atoms (Z=2–18) were calculated by this program. The results for He are given as an example. Author

N68-15955# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ANALYSIS OF STARK EFFECT IN HYDROGEN ATOM [K RASCHETU EFFEKTA V ATOME VODORODA]
M. N. Adamov, V. K. Kagan, and T. K. Rebane *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 37–46 refs (See N68-15951 06-06)

By means of Laplace transformation the wave functions for the ground and lowest excited states of the hydrogen atom in the homogeneous electrical field are constructed in the first approximation of the perturbation theory. The general expression for the first order correction to the unperturbed wave function is obtained by using the recurrent formula for Laguerre polynomials. Author

N68-15967# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON ONE SPECIAL CASE OF NEAR-THRESHOLD BEHAVIOR OF SECTIONS [OB ODNOM SPETSIAL'NOM SLUCHAYE OKOLOPOROGOVOGO POVEDENIYA SECHENIY]
T. V. Zhikhareva *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 (See N68-15951 06-06) p 163–165 refs

The near-threshold behavior of an elastic cross section was considered for the case when the bond energy of an electron in a negative ion is equal to zero. The behavior of reduced inelastic cross sections was also investigated. Author

N68-16018# University of Southern Calif., Los Angeles.
KINETICS AND STATISTICS OF POLYNUCLEOTIDE SYNTHESIS Final Report, 1 Oct. 1959–31 Aug. 1967
Robert Simha and Jack M. Zimmerman Nov. 1967 10 p refs
(Contract Nonr-228(21))
(AD-662276)

Investigations were concerned with two interrelated aspects of biological macromolecules: kinetics of formation and sequence structure. Highlights of the results obtained in these investigations are given and references to all relevant published papers are provided. Specific topics that were considered include: a model for the enzymatic synthesis of RNA-type polynucleotides, single and multicenter template replication of single-stranded DNA, cooperative unwinding and replication of double-stranded DNA, reversible kinetics on linear lattices with nearest neighbor effects (e.g., DNA melting), statistical analysis of polynucleotide sequences in copolymers, and statistical analysis of amino acid sequences in proteins. Plans for future work in some of these areas are described. Author (TAB)

N68-16075*# Volt Technical Corp., Washington, D. C.
ON THE ASYMPTOTIC BEHAVIOR OF THE WAVE FUNCTION OF A SYSTEM OF CHARGED PARTICLES
R. K. Peterkop 23 Jan. 1968 60 p refs Transl. into ENGLISH from Rasseyaniye Elektronov na Atomakh (Riga), 1967 p 35–38
(Contract NAS5-12487)
(NASA-CR-92548; ST-AC-PF-10667) CFSTI: HC $3.00/MF $0.65 CSCL 20H

The asymptotic behavior of the wave function describing collision processes is examined in detail, with attention focused on various aspects of the problem which led to errors in previous solutions. In deriving the equations, consideration is given to the system of neutral particles; neutral and two charged particles; the general case of a system of charged and neutral particles; a model of one-dimensional particles; Temkin's model; and real particles. To obtain a clearer picture of asymptotic behavior, the problem is viewed from the standpoint of classical mechanics. An example of the problem of electron ionization of a hydrogen atom at a total orbital moment of zero is presented. M.G.J.

N68-16076# Joint Inst. for Nuclear Research, Dubna (USSR).
BACK YIELD OF NEUTRONS FROM SHIELDING BOMBARDED BY 600-MEV PROTONS [OBRATNYI VYKHOD NEITRONOV IZ ZASHCHITY POD DEISTVIEM PROTONOV S ENERGIEI 680 MEV]
L. R. Kimel, M. M. Komochkov, V. P. Sidorin, B. S. Sychev, and A. P. Cherevatenko 1967 14 p refs In RUSSIAN
(JINR-P16-3514)

Back yield of neutrons from the concrete shielding is measured (ρ=2.35 g/cm^3). The beam of 660-MeV protons was directed normally to the shielding surface. The experimental data are compared with calculations. Author (NSA)

N68-16077# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Theoretical Physics.
MESON FORM-FACTORS
M. Micu 1967 5 p refs
(JINR-E2-3559)

Some commutation relations obtained from current algebra are considered. They give nontrivial solutions for pseudoscalar meson form factors in the approximation of single particle intermediate state. Author (NSA)

N68-16082 Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).
BROKEN O_8 SYMMETRY AND MASS RELATIONS FOR NUCLEI
Bernard Bremond Dec. 1967 12 p refs
(TH-230)

Wigner's SU_4 symmetry group for nuclei has recently been generalized to include pairing interactions. In the resulting O_8 group, mass relations can be derived and checked with experimental data. A gap is defined which is seen to correspond to that observed in real nuclei. Author

N68-16086# Kaman Aircraft Corp., Colorado Springs, Colo. Nuclear Div.
THE $P^{31}(n,p)$ REACTION AS A PROPOSED STANDARD METHOD FOR MEASUREMENT OF NEUTRON YIELDS FROM THE $D(d,n)He^3$ REACTION

Phillip L. Jessen and Kenneth C. Pierce 14 Feb. 1967 13 p refs Presented at 13th Ann. Meeting of Am. Nucl. Soc., IRD Sect.

A method using the P^{31} (n,p) reaction in an irradiated foil is proposed as a standard means of measuring neutron flux and yields from the D(d,n)He^3 reaction. It is not sensitive to the scattering geometry surrounding the accelerator target. The times required for the measurement are short enough to make the measurement convenient for most applications. Preparation of the foils is described. Calculations for an example of radiation escaping from a uniform thin disc of radioactive material which absorbs its radiation uniformly, are presented. L.S.

N68-16101*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.

PHYSICS PROGRESS REPORT, 1 OCTOBER 1965–1 OCTOBER 1966

1 Oct. 1966 124 p

(Contracts NASw-37; NAS-2053; NAS5-3205; Grant NSG-386; Contract AT(30-1)-2098 et al)

(NASA-CR-91866; MIT 2098/299; PR-69) CFSTI: HC $3.00/MF $0.65 CSCL 20H

Various photoproduction, meson–proton, meson decay, and electron interactions are described. The development and use of computers, wire spark chambers, hodoscopes, other detectors, and external beam facilities are discussed. In cosmic ray studies, work is reported on X-ray astronomy, high energy gamma ray astronomy, infrared astronomy, and a lithium-drifted germanium detector for gamma ray lines. Various theorical studies for elementary particle interactions are described. Differential cross sections for beryllium isotope nuclear reactions were measured, and angular distributions were derived. A number of (d,p) and (He–3,p) reactions were investigated. The gyromagnetic ratios of +2 states in the even–even Te isotopes were measured using the method of perturbed angular correlations after Coulomb excitation ion implantation. The energy levels of Ni^{64}, Ti^{48}, and Zr^{90} were investigated by alpha inelastic scattering. Other work is also reported. L.S.

N68-16102# Laboratoire de Physique Theorique et des Hautes Energies, Orsay (France).

TCP INVARIANCE, TIME REVERSAL INVARIANCE, AND K MESON DECAY

M. Gourdin Nov. 1967 46 p refs Presented at 3d Tokyo Summer Inst., 14–19 Sep. 1967

(TH/224)

The existence of possible discrete symmetries in K-meson decay is discussed by considering TCP or time reversal for the case that the PC invariance does not hold. Quantum mechanical analysis of the K^+K^* complex derives the unitary relation as a consequence of the conservation of probabilities. Special attention is given to the 2π mode where the violation of PC invariance has been measured. A similar situation occurs at time-reversal invariance with a one to one correspondence. It is assumed that the unitary relation is dominated by the 2π contributions and four TCP invariant solutions, and four time-reversal invariant solutions are obtained. Recent experiments showing an asymmetry in the leptonic modes K_{e3} and $K_{\mu 3}$ are considered in relation with the TCP invariant solutions. G.G.

25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N68-15020# Institut Franco-Allemand de Recherches, St. Louis (France).

THEORETICAL AND EXPERIMENTAL STUDY OF IONIZED WAKES [ETUDE THEORIQUE ET EXPERIMENTALE DES SILLAGES IONISES]

M. Lang 30 Mar. 1967 22 p refs In FRENCH

(ISL-T-9/67)

An updated review is presented of the chemical processes during the ionization of the wake of a hypersonic projectile. This is followed by a discussion of the results obtained in an experiment in which measurements were made by cavity resonator and by microwave interferometer. Transl. by K.W.

N68-15149# Yale Univ., New Haven, Conn.

DENSITY OF STATES AND FERMI ENERGY FOR CHARGED PARTICLES IN A UNIFORM MAGNETIC FIELD

Don Kelly [1967] 9 p

(Contract Nonr-609(51))

(AD-662907)

Quantum mechanical calculations are presented for the density of states and Fermi energy. TAB

N68-15151# Atomic Weapons Research Establishment, Aldermaston (England).

ELECTRICAL BREAKDOWN BETWEEN A PLASMA AND AN ELECTRODE AT A NEGATIVE POTENTIAL

W. D. Owen Nov. 1967 14 p refs

(AWRE-O-78/67) HMSO: 1s 9d

An analysis is made of the interaction between a plasma and an electrode at a negative potential. Expressions are derived for the electric field produced at the electrode surface as a result of the presence of the plasma and a possible mechanism of electrical breakdown based on field emission is considered. The parameters to be considered in the design of ion extracting electrode systems and the limits set on these in order to avoid field emission initiated electrical breakdown are outlined. Author

N68-15199# Institut Franco-Allemand de Recherches, St. Louis (France).

DETERMINATION OF THE ELECTRONIC DENSITY OF A PLASMA BY THE MEANS OF A DOUBLE SOUNDING [DETERMINATION DE LA DENSITE ELECTRONIQUE D'UN PLASMA AU MOYEN D'UNE DOUBLE SONDE]

J. Kaprelian 27 Dec. 1966 18 p refs In FRENCH

(ISL-T-40/66)

A theoretical interpretation is presented of the ionic saturation current of the characteristics I(V) obtained with a Langmuir probe and a double sonde. The theory is applied to determine the electron density of a plasma. Transl. by K.W.

N68-15238# United Kingdom Atomic Energy Authority, Culham (England).

IMPROVEMENT OF THE CUSP LOSS RATE BY THE APPLICATION OF AN ADDITIONAL MIRROR FIELD

Koji Uo Jun. 1966 22 p refs

(CLM-M-61)

A fusion reactor based on confinement by a cusped magnet field is feasible if the so-called cusp hole size can be decreased to 1/10 of an ion Larmor radius. The use of a physically small but strong mirror field outside the cusp tip is proposed as a method of decreasing the effective size, without greatly increasing the total magnetic field energy. The velocity distribution of the particles escaping from the cusp tip of a $\beta = 1$ cusped magnetic field

is calculated by using Berkowitz's theory. This velocity distribution is favorable for the mirror effect. The total loss rate, i.e., the effective hole size, decreases by the factor $4\lambda^{-3/2}/\pi$ in the case with no electric field in the boundary layer and $4\lambda^{-2}/\lambda$ in the case with an electric field. λ is the mirror ratio, i.e., the ratio of the mirror field intensity to the field intensity at the cusp tip. Finally, the particle confinement time in the general multipolar cusped magnetic field is calculated. Author (NSA)

N68-15295# Yale Univ., New Haven, Conn.
STATISTICAL THEORY OF EMISSION, ABSORPTION AND CONDUCTIVITY OF RADIATION IN FULLY IONIZED PLASMAS
Dae Mann Kim [1967] 26 p refs
(Contract Nonr-609(51))
(AD-662910)

Kinetic equations for the time evolution of the radiation modes in fully ionized plasmas with steady electron and ion distributions are derived. The work results in formulas for emission, absorption, and conductivity which include the collective behavior of the plasma. Author (TAB)

N68-15299# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
A BRIEF REVIEW OF THE LITERATURE CONCERNING THE STABILITY OF THE INTERFACE BETWEEN TWO FLUIDS IN RELATIVE MOTION
Richard A. Gerwin Oct. 1967 27 p refs
(D1-82-0659)

The problem of the Kelvin–Helmholtz instability of a plane interface between two fluids in relative motion parallel to their interface is reviewed. A literature survey of previous work connected with refinements of this problem working with 1) incompressible fluids, 2) compressible fluids, 3) incompressible magnetohydrodynamic fluids, and 4) compressible magnetohydrodynamic fluids, is presented. L.S.

N68-15311# Air Force Cambridge Research Labs., Bedford, Mass.
TURBULENT EDDIES IN HIGH-DENSITY-SPARK CHANNELS IN HELIUM
Heinz Fischer and Karlheinz Schoenbach Dec. 1967 16 p refs
Phys. Sci. Res. Papers, No. 344
(AFCRL-67-0544; AD-662346)

Turbulent eddies in high-pressure microsecond-spark channels in helium were photographed by means of a 20-nsec Kerr-cell shutter. Current densities exceeded 1,000,000 A/sq. cm. It was shown that turbulences are initiated from plasma jets originating at the electrodes. The cathode jet is explained by Comptons accommodation theory which was extended by Haynes. The observed anode shock wave appears to be the result of a dynamic magnetic pinch. Author (TAB)

N68-15473# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
ON THE QUESTION OF DRAG ON A SPHERE IN MAGNETOHYDRODYNAMIC FLOW
H. H. Branover, N. M. Slyusarev, and A. B. Cinober Jan. 1968 5 p refs Transl. into ENGLISH from Magnetohydrodyn., no. 3, 3. 1966 p 149–150
(TR-48)

As magnetohydrodynamic flows around geometrically simple bodies provide a basis for a better understanding of the behavior of measurement probes in such flows, some experimental results on the MHD drag on spheres are reported. Using strain gages on the sphere suspension system, a linear relationship between MHD sphere drag and flow velocity at sufficiently high magnetic field strengths was found. Author

N68-15488# Yale Univ., New Haven, Conn.
MICROWAVE HARMONICS IN A PLASMA: A SURVEY
Don Kelly [1967] 20 p refs
(Contract Nonr-609(51))
(AD-662909)

The report surveys the experimental and theoretical papers concerned with microwave harmonics in plasmas. The two central problems which command most of the attention are (1) the development of coherent sources of millimeter power, and (2) harmonic effects on the propagation of electromagnetic waves through plasmas. TAB

N68-15518# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Laboratorio Gas Ionizzati.
INTERACTION OF AN ELECTRON BEAM WITH A COLLISIONLESS PLASMA
M. Carnevale, B. Crosignani, and F. Engelmann Mar. 1966 25 p refs Sponsored by EURATOM
(LGI-66/6)

The growth of electrostatic wave excitation and the modification of the electron beam in interaction with a collisionless plasma are studied for weakly unstable situations. Using quasi-linear theory, explicit results, as a function of space, time, and the parameters of the plasma and the beam, are obtained for the surface layer where the relaxation of the beam takes place effectively. The effect on the beam of both unstable modes and the resonant stable modes of thermal excitation is considered. Author (NSA)

N68-15521*# Texas Univ., Austin. Plasma Dynamics Research Lab.
PROPAGATION AND DISPERSION OF HYDROMAGNETIC AND ION CYCLOTRON WAVES IN PLASMA IMMERSED IN MAGNETIC FIELDS Semiannual Status Report, 15 Jul. 1967–14 Jan. 1968
Otto M. Friedrich, Jr. 15 Jan. 1968 54 p refs
(Grant NsG-353)
(NASA-CR-92583; SASR-10) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experimental and theoretical investigations of ion cyclotron waves and related wave phenomena in magnetoplasma are discussed. Experimental facilities for the generation and detection of harmonic ion cyclotron waves and the fast wave associated with the ion cyclotron wave are described. Results are presented from the initial tests of a preionization device of the reflex PIG type. An analysis is presented of the Stix coil as a means of exciting quasistatic ion cyclotron waves. In the first approximation, coupling to the wave is shown to be a secondary effect, as the primary fields of the Stix coil do not couple directly to the wave. An outline is presented of the formalism for calculating the coupling coefficients of the Stix coil for quasistatic ion cyclotron waves assuming cold plasma boundary conditions. Experimental investigations of propagation of the fast hydromagnetic wave are presented. It is shown that the observed propagation in bands can be explained in terms of higher order transverse and azimuthal modes and that, with this assumption, the predicted waveguide cut-off is in agreement with the experimentally observed cut-offs. Author

N68-15633# Hughes Research Labs., Malibu, Calif.
RESEARCH DIRECTED TOWARD THE STUDY OF IONIC AND NEUTRAL SPECIES IN THERMAL PLASMAS Final Report, Aug. 1, 1964–Aug. 31, 1967
H. Heil, B. W. Scott, and J. V. Hollweg Sep. 1967 165 p refs
(Contract AF 19(628)-4297)
(AFCRL-67-0500; AD-662636)

Two sets of experiments were designed to study the gas discharge in cesium plasma thermionic converters. The first experiments measured the energy spectra of charged particles extracted through a small hole in the anode of an operating energy converter. From these ion and electron spectra the temperatures were deduced and the emitter sheath height was measured. The second experiments were to investigate cross sections relevant to an understanding of the ionization processes present in the converter. The ionization and charge exchange cross sections were studied in detail. In addition to the various cross sections, the reflection of zero energy electrons at surfaces was investigated both by experiment and by computer experiment. Results and experimental techniques are described in detail. Author (TAB)

N68-15645# Aerospace Research Labs., Wright-Patterson AFB, Ohio.
AN APPROACH TO RADIATION SOURCE DESIGN FOR MILITARY APPLICATIONS UTILIZING THE WALL-STABILIZED ARC AS AN EXAMPLE Final Scientific Report
Paul W. Schreiber and Kenneth R. Benedetto Aug. 1967 39 p refs
(ARL-67-0179; AD-662350)

An approach to the selection of radiation sources for military applications is presented. A logical breakdown of the various types of discharge sources and a list of parameters to be considered are given. As an example, an analytical and experimental study of the fully developed, laminar flow, argon electric arc discharge is included. A description of the arc facility and the diagnostic techniques used are presented. The analytical results are compared with experimental results. Author (TAB)

N68-15727# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DYNAMIC DECOMPENSATION OF THE SPACE CHARGE OF ION BEAMS DURING ELECTROMAGNETIC SEPARATION OF ISOTOPES [O DINAMICHESKOY DEKOMPENSATSII PROSTRANSTVENNOGO ZARYADA IONNYKH PUCHKOV PRI ELEKTROMAGNITONOM RAZDELENII IZOTOPOV]
B. Ye. Gavrilov, A. V. Zharinov, and V. I. Rayko 31 Mar. 1967 16 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Otd. Tekhn. Nauk: Energ. i Avtom. (Moscow), no. 592, 1964 p 3–20
(FTD-MT-66-148; AD-663349)

An attempt is made at an elementary theoretical generalization of certain properties of intense ion beams, primarily for the purpose of finding possible methods of controlling dynamic decompensation. It is shown that the geometrical properties of beams extracted from plasma obey the laws of similarity. On the basis of these laws, general relationships are established which correlate the plasma density pulsations in the source, the angular divergence, the degree of dynamic decompensation, and the beam potential. The elementary theoretical analysis used shows that the regimes most favorable from the standpoint of dynamic decompensation of ion beams are those corresponding to divergent beams. Under these conditions, the degree of dynamic decompensation is minimal and is the same in order of magnitude as the relative pulsation of plasma density in the discharge. Therefore, since it is always possible to select regimes where the pulsations of angular divergence become unimportant, a further increase in the intensity of compensated ion beams will require the development of methods for substantially decreasing the level of current density pulsations in the discharge. Author (TAB)

N68-15747*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELECTRICAL PROPERTIES OF XENON-FILLED THERMIONIC DIODES IN RADIATION FIELD OF A NUCLEAR REACTOR
Ralph Forman Washington Feb. 1968 17 p refs
(NASA-TN-D-4368) CFSTI: HC $3.00/MF $0.65 CSCL 18I

Experimental data on nuclear-irradiated xenon-gas-filled thermionic diodes are presented. The characteristic curves for the irradiated diodes were studied as a function of xenon pressure (4 to 300 torr (5×10^2 to 4×10^4 N/m^2)), nuclear radiation intensity (gamma dose rate 10^6 to 6×10^6 rads/hr (10^6 to 6×10^6 J/(kg)(hr))), emitter temperature (1000° to 1200°C), and electrode spacing (0.025 to 0.75 cm). Some interesting breakdown pehnomena occurred at voltages much lower than the first excitation potential. Some of the breakdown effects showed characteristics similar to those obtained in low-temperature cesium thermionic converters. There are regions corresponding to the unignited mode, preignition, and the ignited mode. In some cases, depending on the choice of radiation intensity, xenon pressure, and interelectrode spacing, these breakdown modes occur at applied voltages as low as 1 volt. Author

N68-15828*# Stevens Inst. of Tech., Hoboken, N. J. Dept. of Physics.
AN EXPERIMENTAL AND THEORETICAL INVESTIGATION OF TURBULENCE INSTABILITIES AT PLASMA MAGNETIC FIELD INTERFACES Semiannual Report for Period Ending Apr. 1967 and Final Report for Period Ending Jan. 1968
Winston H. Bostick Jan. 1968 22 p
(Grant NsG-596)
(NASA-CR-92518; SIT-P206) CFSTI: HC $3.00/MF $0.65 CSCL 20I

Experiments were conducted with probes and the plasma camera on plasma moving across a homogeneous magnetic field, and the results show that the parallel-to-B_o plasma vortex structure can be extremely complex at low magnetic fields. At magnetic fields above 1000 gauss, the plasma assumes a much more regular shape and apparently rolls like a caterpillar tractor track as it moves across the field. It was also found that the firing of a two-wire button plasma gun into a magnetic field with a gradient produces not only a curved trajectory for the plasma, but the plasma ends up in a perpendicular-to-B_o vortex structure. It was concluded that the data obtained show how minimum B works as a containment device: the trajectories of the blobs of plasma in the gradient fields are curved by $j\times B$ forces; the current loops of the current density j can be drawn in a semiquantitative way. Author

N68-15888# United Kingdom Atomic Energy Authority, Culham (England).
A MAGNETOHYDRODYNAMIC SHOCK IN A PLASMA WHERE THE DISSIPATIVE MECHANISM IS ION ACOUSTIC WAVE INSTABILITY
J. H. Adlam Feb. 1968 18 p refs
(CLM-M-59)

Magnetohydrodynamic shock profiles are calculated where the dissipative mechanism is ion acoustic wave instability. A number of assumptions were made to obtain numerical solutions. These assumptions are discussed with references to recent published works. It is found that, when the effects of ion acoustic wave turbulence are dominant, there should be a limiting shock strength above which it is not possible to obtain a mathematical shock solution. Author (NSA)

N68-15957# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

METHOD OF MODULATED ELECTRON BEAM AND ITS APPLICATION TO STUDY OF OPTICAL EXCITATION FUNCTIONS [METOD MODULIROVANNOGO ELEKTRONNOGO PUCHKA I YEGO PRIMENENIYE K IZUCHENIYU OPTICHESKIKH FUNKKTSIY VOZBUZHDENIYA]

I. I. Geytsi *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 55–65 refs (See N68-15951 06-06)

A photoelectric photometer with an automatic recorder of the intensity of spectral lines indicating the energy of electron excitation was constructed to study the optical excitation functions of atoms by the modulated electron beam method. A study of the excitation function of the hyperfine components of the mercury λ5461Å spectral line established that there is no noticeable difference in the form of the excitation function. A study of the excitation functions of 10 spectral lines of helium showed that they have one maximum at about 30–40 ev. On adding Hg, Kr, H_2 or Xe to the He a secondary maximum appears near the threshold of excitation on the curves of the excitation functions of the spectral lines of the S- and D-series; addition of Ne does not change the form of the optical excitation functions of He. It was established that this secondary maximum cannot be explained by the polarization of the radiation near the excitation threshold on electron impact, by the formation of groups of electrons with different rates, or by the improvement in the monolineticity of the electron beam.
Author

N68-15987# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF THEORY OF THE ELECTROMAGNETIC FIELD

Krystyn Bochenek *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 59–61 refs (See N68-15982 06-34)

Research activities on magnetohydrodynamics and plasma theory are briefly mentioned, and include transformation of electromagnetic into magnetohydrodynamic waves, and creation of of current layer, magnetogasdynamic waves, and nonlinear macroscopic plasma problems. Diffraction patterns of electromagnetic waves from an antenna above conducting earth were examined. The electrodynamics of gyrotropic media was investigated, centering on the diffraction in an axially anisotropic medium and microwave problems connected with waveguides filled with ferrite. N.E.N.

N68-16007*# California Univ., Los Angeles. Dept. of Physics.

PARAMETRIC COUPLING BETWEEN DRIFT WAVES

F. Hai, R. Rowberg, and A. Y. Wong Oct. 1967 11 p refs
(Grant NGR-05-007-066)
(NASA-CR-92566; R-17) CFSTI: HC$3.00/MF$0.65 CSCL 20I

Preliminary experimental results are reported on the nonlinear phenomenon of parametric coupling between drift waves in a plasma. This coupling involves the excitation of a low mode number drift wave by a "pump" drift wave at a higher mode in a cesium plasma of a single ended Q device. A probe biased at about the plasma potential provides pump wave excitation and a Langmuir probe monitores the drift wave. Wave amplitudes of both the pump wave and the excited wave increase with incressed voltage of the oscillator. Results show that the threshold for parametric excitation of a mode frequency depends upon damping associated with this mode. G.G.

N68-16011# Yale Univ., New Haven, Conn.

THE ELECTRICAL CONDUCTIVITY OF A RELATIVISTIC PLASMA

Don Kelly [1967] 11 p
(Contract Nonr-609(51))
(AD-662904)

The report extends one aspect of plasma kinetic theory to include relativistic effects. Specifically, relativiatic modifications of the electrical conductivity are studied using a covariant form of the Boltzmann equation. The electrons are assumed to undergo Coulomb collisions with the ions. Electron-electron collisions and Compton scattering are ignored. The dynamic effects produced by an external magnetic field are included, but the important modifications resulting from cyclotron emission are neglected. The plasma is assumed to be tenuous so that collective effects are ignorable.
Author (TAB)

N68-16052# Columbia Univ., New York. Plasma Lab.

TRANSVERSE PLASMA TRANSPORT DUE TO DRIFT WAVES IN A MAGNETOPLASMA

Karl Josephy 1967 113 p refs
(Grant NSF GK-125)
(Rept.-37)

Experiments were conducted to determine the drift wave or universal instability on the transverse loss of plasma in an alkali metal Q-machine plasma. Details are given on the Q-machine which produces a highly ionized quiescent plasma by contact ionization of neutral alkali metal vapor on a hot tungsten plate. To permit a high degree of ionization, plasma is generated in a cooled vacuum chamber which then maintains a low background neutral gas pressure. The theory of drift waves is described. An equation for the radial variation of the drift wave potential was derived and solved on a computer for a cylindrical plasma with a radial number density gradient and bounded by a metal radial boundary. Theoretical approaches of treating the problem of transverse particle loss are assessed, and a technique of using free streaming plasma pulse to measure transverse diffusion is described. Consideration is also given to diffusion experiments with naturally occurring drift waves and driven drift waves. It was concluded that the effect of naturally occurring drift waves can be reduced by minimizing the energy available for their excitation, or by limiting their longitudinal wavelength. M.G.J.

N68-16079# Columbia Univ., New York. Plasma Lab.

EXPERIMENTAL INVESTIGATIONS OF NORMAL IONIZING SHOCK WAVES

Leslie S. Levine 1967 162 p refs
(Contract AF 49(638)-1634)
(AFOSR-68-0023; Rept.-36; AD-663212)

Experiments were conducted on normal ionizing shock waves produced in a coaxial electromagnetic shock tube. Steady shock velocities were measured as a function of initial gas pressure, drive current, and applied axial magnetic field. The speeds agreed well with theoretical values. Shocks propagating at transAlfvenic speeds were studied. Measurements were made of the upstream transverse electric field and the switch-on magnetic field. Further support for this theory was provided by the measured compression ratio across the shock front. It was concluded that transAlfvenic normal ionizing shocks exhibited Chapman-Jouguet behavior with current flow in the shock front, and no separation of shock and drive currents. In contrast, superAlfvenic shocks appear to be gas dynamic in nature. Spectroscopic measurements and shock reflection studies demonstrated the presence of a nonluminous front and shock heated gas preceding the drive current. The luminosity front acts as a contact surface separating the unequilibrated shock from the luminous current. Finite transverse electric fields and switch-on behavior were observed at superAlfvenic shock speeds. Both of these effects were attributed to the finite conductivity of the plasma.
Author (TAB)

N68-16091*# Massachusetts Inst. of Tech., Cambridge. Fluid Mechanics Lab.
A BOUNDARY-LAYER MODEL FOR BALANCED ARCS
Martin D. Cowley Jul. 1967 94 p refs
(Grant NGR-22-009-052)
(NASA-CR-92514; Publ.-67-6) CFSTI: HC $3.00/MF $0.65 CSCL 20I

The report discusses two-dimensional arcs which are held stationary against the drag of a stream of gas by the force due to an imposed, transverse, magnetic field. In the proposed model, the arc column is a region which is by-passed by the external stream, but which contains an internal circulatory flow. The effective Reynolds number of the circulation is high enough to justify, as a possible and interesting limit, an analysis in which the action of viscosity and heat conduction are assumed to be confined to thin layers. Gas is supposed to drift forward slowly in an inviscid core of the arc and to be returned rapidly in thin shear layers at the edges. An important consequence is that the state of the gas must be constant along a field line in the core, and the model would be invalid if any field lines are closed within the column. A solution is found to the equations governing the shear layers in the vicinity of the forward stagnation point of the arc. A qualitative discussion suggests that the action of electromotive forces induced by the flow reduces velocity levels in the shear layers and thickens them, while longitudinal flows, predominantly from cathode to anode, are caused by the Hall effect. Author

N68-16092# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
ELECTRON-HOLE PLASMA DENSITY MEASUREMENTS
Wen Shuh Chan and Betsy Ancker-Johnson Jun. 1967 11 p refs Sponsored in part by NSF Prepared in cooperation with Washington Univ.
(D1-82-0824)

A diagnostic tool to determine the spatial and temporal distribution of nonequilibrium electron-hole plasma has been made utilizing a N_2–CO_2 cw laser and a Cu-doped Ge detector. Measurements of distribution have been made on an injected and subsequently pinched plasma contained in p–InSb at $\approx 77^{\circ}$K. The results show that the method has excellent spatial and time resolution. Author

N68-16096# Commissariat a l'Energie Atomique, Saclay (France). Centre d'Etudes Nucleaires.
POWER DISSIPATED (OR GENERATED) BY THE VARIOUS EXCITED MODES IN A PLASMA [PUISSANCE DISSIPEE (OU GENEREE) PAR LES DIFFERENTS MODES EXCITES DANS UN PLASMA]
Paul Rolland Jul. 1967 53 p refs In FRENCH
(CEA-R-3288; IGn/RT-529)

The energy exchange between a plasma and a source of excitation sin $w_0 t$ is investigated. In order to include the case of growing waves associated with convective instabilities, this problem is treated in the context of the wave-packet theory, by writing the field as a double integral in two complex planes. The paths of integration are defined after a separation into two classes of the roots k(w) of the dispersion equation. It is found that, even in the absence of collisions, there still is a power exchange, due to the spatial dispersion. Thus a connection can be established with the kinematic theories of growing waves and the modes generating power can be found. Moreover, the power dissipated by spatial dispersion is found to be identical with that due to Landau's effect for long waves. This confirms the kinematic character of the latter and bridges a gap between macroscopic and microscopic theories. Author (NSA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N68-15021 Technische Hochschule Hannover (West Germany).
FIELD EFFECT MEASUREMENTS OF N-GERMANIUM [FELDEFFEKTMESSUNGEN AN N-GERMANIUM]
Juergen Koetter (Ph.D. Thesis) 1967 87 p refs In GERMAN

Field effect measurements were made on thin, rectangular, single crystal chips of high-ohm n-germanium in order to determine terminal density and energy data of the fast levels at the boundary of the germanium and the oxidation layer. Measurements were made simultaneously on both large surfaces of the thin chips. Strictly identical surface preparation of the germanium samples prior to the measuring was stressed. Also determined were the effects of hydrogen gas, oxygen gas, and water vapor on the electronic structure and properties of the semiconductor surface. The tests were conducted in a high vacuum. Temperatures were varied, and several different heat treatment techniques were applied. Transl. by K.W.

N68-15084# Massachusetts Inst. of Tech., Cambridge.
ELECTRONIC CONFIGURATION OF INDIUM ANTIMONIDE SURFACES
Howard R. Huff, Shinji Kawaji, and Harry C. Gatos Nov. 1967 22 p refs
(Contract Nonr-3963(05))
(TR-8; AD-663092)

Large signal alternating current field effect experiments on surfaces of n and p-type InSb yielded results which were found to be consistent with a model according to which the discrete fast states near the valence and conduction band edges are acceptor-like, characteristic of the antimony and indium species, respectively. This model was extended to emphasize the importance of sub-surface states. The electrical properties of these surfaces was correlated with their chemical and structural characteristics and was found to be consistent with the Gatos-Lavine model of the dangling bonds on the III-V compound surfaces. TAB

N68-15118*# Stanford Univ., Calif. Solid State Lab.
PHOTOEMISSION STUDIES OF THE NOBLE METALS, THE CUPROUS HALIDES, AND SELECTED ALKALI HALIDES
Walter F. Krolikowski May 1967 432 p refs
(Grants NGR-05-020-066; NSF GP-1033; Contract ARPA SD-87)
(NASA-CR-92571; SEL-67-039; TR-5218-1) CFSTI: HC $3.00/MF $0.65 CSCL 20L

In order to test the validity of explanations for the optical spectrum of the cuprous halides, the electronic properties of these halides have been investigated in detail by use of experimental photoemission techniques. The quantum yield and photoemission data resulting from these measurements have been interpreted in terms of the electronic structure, and it is found that the copper d band plays a significant role in the valence band. In order to distinguish the copper d band from the halogen p bands, it was found useful to extend the photoemission studies to the noble metals and the alkali halides. Consequently, this report includes not only studies of the cuprous halides (CuCl, CuBr, CuI), but also detailed studies of the noble metals (Cu, Ag, Au) and certain alkali halides (CsCl, CsBr, CsI, and KI). Author

N68-15143*# Rensselaer Polytechnic Inst., Troy, N. Y.
[INTERDISCIPLINARY MATERIALS RESEARCH PROGRAM] Semiannual Progress Report, 1 Mar.–31 Aug. 1967
Sep. 1967 49 p refs
(Grant NsG-100-60)
(NASA-CR-91779) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Technical reports are presented on several areas in materials research. Inorganic nonmetallic material studies center on the structures and properties of glasses, and uncommon noncrystalline solids; preparation of high temperature materials; and thermodynamics and kinetics of gas phase reactions, and measurements of electrical properties of crystalline semiconducting solids. Projects on the metallic solids include the mechanical properties of dispersion strengthened alloys, interaction of dislocations with discrete second-phase particles in dispersion-strengthened alloys, stress corrosion cracking of copper-base alloys, and metallic dissolution. The mechanical and thermal properties of polymers are presented along with polymer characterization and irreversible thermodynamics of the solid state of linear high polymers. In solid state physics research, emphasis is placed on magnetic and electron spin resonance, ultrasonic propagation, X-ray diffraction, and thermal measurements in a liquid helium temperature range. B.S.D.

N68-15169# Carnegie Inst. of Tech., Pittsburgh, Pa. Metals Research Lab.
STUDIES OF THERMALLY ACTIVATED COUPLED-CURRENT PROCESSES Final Report
G. M. Pound 1 Nov. 1967 2 p refs
(Grant AF-AFOSR-607-64)
(AFOSR-67-2789; AD-662613)

A brief summary of scientific achievement is given. These achievements include a treatment of homogeneous nucleation in condensation; a theoretical analysis of the Onsager off-diagonal coefficients in diffusion in ternary interstitial solid solutions, and surface self-diffusion studies on tungsten, molybdenum and copper by field emission microscopy. Author (TAB)

N68-15229# Northwestern Univ., Evanston, Ill. Materials Research Center.
ANNUAL REPORT, 1 OCTOBER 1966–30 SEPTEMBER 1967
30 Sep. 1967 173 p refs
(Contract ARPA SD-67)
(AR-8; AD-663099)

The document is comprised of summaries of the 37 projects in progress during the reporting period. A list of published papers accompanies each summary. TAB

N68-15241# Robert Bosch G.m.b.H., Stuttgart (West Germany).
METHODS FOR REVEALING INHOMOGENEITIES IN ANODIC TANTALUM OXIDE FILMS [VERFAHREN ZUR SICHTBARMACHUNG VON INHOMOGENITAETEN IN ANODISCHEN TANTALOXIDSCHICHTEN]
G. Krueger Bad Godesberg, W. Ger. Bundesmin. fuer Wiss. Forsch. May 1967 55 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-06)

Oxide films prepared by anodic oxidation of valve metals and provided with metal contacts have a considerably lower break-down voltage than in the electrolyte. The cause for this phenomenon lies in local inhomogeneities in the oxide. New photoelectric and electron-microscopic processes for revealing such weak spots are described. The results of such investigations agree with those obtained by previously published processes, and show, in addition, possible ways of improving the dielectric properties of anodic oxide films. Author

N68-15327# Sperry Microwave Electronics Co., Clearwater, Fla.
LOW MAGNETIC SATURATION GARNETS Quarterly Progress Report, 1 May–31 Jul. 1967
L. R. Hodges, Jr., G. P. Rodrigue, and G. R. Harrison Nov. 1967 35 p ref
(Contract DAAB07-67-C-0142)
(SJ-200-4526-2; ECOM-0142-2; Rept.-2; AD-662277)

Four single crystal runs of gallium substituted BiCaVIG were conducted. The magnetization of the crystals increased from 545 to 677 gauss as the Ga_2O_3 substitution was increased from 0 to 3%. The gallium distribution in the crystals of a BiCaVIG crystal run is considerably more uniform than that observed in the gallium substituted YIGs. The effect of B_2O_3 additions on particle size and Fe_2O_3 content on remanent properties for polycrystalline BiCaVIG are described. Qualitative magnetostriction tests have been conducted on selected YIG, BiCaVIG and BiCaV(Al)IG compounds. The data indicates very little magnetostriction exists in the vanadium garnet compounds. Preliminary operating characteristics of an S band digital phase shifter containing polycrystalline toroids of BiCaVIG are described. Author (TAB)

N68-15389# Tufts Univ., Medford, Mass. Dept. of Physics.
INVESTIGATION OF THE ULTRASONIC ATTENUATION IN IRRADIATED METALS Final Report, 15 Jan. 1964–15 Nov. 1966
Kathryn A. McCarthy, Edward Y. Wang, and Robert J. Kolouch 13 Jun. 1967 133 p refs
(Contract AF 19(628)-4029)
(AFCRL-67-0369; AD-662870)

Measurements of the ultrasonic attenuation of phonons in samples of pure copper and aluminum were undertaken to determine the effects of gamma irradiation on the electron-phonon interaction and the phonon-dislocation interaction in normal metals. From these measurements the absolute electronic attenuation was determined, as well as the temperature dependence of the electron mean free path at low temperatures. The measurements revealed that the ultrasonic attenuation in copper is orientation-dependent, and that the attenuation in aluminum is orientation-independent. The electron-phonon interaction in copper is orientation-dependent; the electron-phonon attenuation in aluminum is orientation-independent. The dislocation-phonon interaction in copper is also orientation-dependent, whereas in aluminum no dislocation-phonon interaction was detected. Author (TAB)

N68-15500# Massachusetts Inst. of Tech., Cambridge.
OBSERVATION OF QUANTUM GALVANOMAGNETIC PHENOMENA IN N-TYPE INDIUM ANTIMONIDE
Howard R. Huff, Shinji Kawaji, and Harry C. Gatos Dec. 1967 40 p refs
(Contract Nonr-3963(05))
(TR-9; AD-663093)

Quantization effects in the bulk galvanomagnetic properties of n-type InSb were studied in conjunction with the transport properties of compound semiconductor surfaces. The transverse and longitudinal magnetoresistivity were measured at 4.2, 50 and 77K. The former was found to increase with increasing magnetic field at all temperatures and (for a given temperature) was an order of magnitude larger than the latter which became saturated at the two higher temperatures. At 4.2K, the electrons were weakly degenerate and the bulk mobility was determined by screened ionized impurity scattering. At 77K, the electrons were non-degenerate and the predominant scattering mechanism was probably low temperature optical phonon scattering. Author (TAB)

N68-15522# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CERTAIN CHARACTERISTICS OF RADIATIVE CENTERS IN SYNTHETIC GERMANIUM-DOPED QUARTZ [NEKOTORYYE OSOBENNOSTI RADIATSIONNYKH TSENTROV SINTETICHESKOGO KVARTSA, AVTIVIROVANNOGO GERMANIYEM]
Sh. Vakhidov, G. Ikramov, and B. Kaipov 28 Jul. 1967 8 p refs Transl. into ENGLISH from Akad. Nauk Uz. SSR. Izv. Ser. Fiz-Mat. Nauk (USSR), no. 4, 1966 p 50–52
(FTD-HT-67-426; AD-663345)

Electron paramagnetic resonance (EPR) was used in an investigation of the radiative effects in crystalline quartz activated with impurities of germanium, aluminum, and some alkali metals. Al impurities appear independently on the spectrum. Several tens of millions of roentgens are required to saturate the Griffiths-Owen-Ward (GOW) centers; smaller doses, of the order of several million of roentgens, are required to saturate the 1 and 2 centers. The GOW and 1 and 2 centers are shown to appear as the result of irradiation and disappear, independently of each other, as the result of thermal or optical annealing. Investigation of the absorption spectra showed also that GOW and 1 and 2 centers exist independently from each other, have different probabilities of formation under the effect of ionizing radiation, and can be annealed independently when heated or illuminated. TAB

N68-15537*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION OF THE FORCES ACTING ON AN IMPURITY OF A METAL SUBJECTED TO A TEMPERATURE GRADIENT [CALCUL DES FORCES AGISSANT SUR UNE IMPURETE D'UN METAL SOUMIS A UN GRADIENT DE TEMPERATURE]
Maurice Gerl Jan. 1968 32 p refs Transl. into ENGLISH from Comm. a l'Energie Atomique, Saclay, France, Rept. CEA-R-3096, Dec. 1966 p 1–38
(NASA-TT-F-11409; CEA-R-3096) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Within the limits of the stated approximations it is shown that in the case of self-diffusion the friction of charge carriers contributes little to the heat transport of the point defect, at least in normal metals. In transition metals the contribution of the electrostatic force due to the thermoelectric field may be much greater (approximately 0.1 eV in Pt). It is shown that in thermal diffusion of impurities the effect of carrier friction can be substantial for elements whose valences differ from that of the matrix. Author

N68-15567# Aerospace Corp., El Segundo, Calif. Lab. Operations.
ACCURACY OF LATTICE PARAMETER MEASUREMENTS IN A SMALL CRYSTALLOGRAPHIC RESEARCH LABORATORY
Gerard M. Wolten Sep. 1967 40 p refs
(Contract F04695-67-C-0158)
(TR-0158(3250-10)-8; SAMSO-TR-67-99; AD-663233)

An experimental investigation was conducted into the precision and accuracy with which lattice parameters can be determined under realistic operating conditions. The work included precision alignment of x-ray diffractometers. The lattice parameter project of the International Union for Crystallography is described as an introduction to the work. Special problems applying to materials that are highly transparent to x rays are considered. Data reduction by a least-squares computer program is discussed. Author (TAB)

N68-15600# Boeing Scientific Research Labs., Seattle, Wash. Plasma Physics Lab.
MAGNETOCONDUCTANCE OF NONEQUILIBRIUM PLASMAS IN InSb
Betsy Ancker-Johnson Aug. 1967 25 p refs
(D1-82-0650)

The conductance of injected and impact-ionized plasmas in p–InSb at 77°K has been measured as a function of amplitude and direction of magnetic field relative to the electric field strength. Very large anisotropy in magnetoconductance occurs as the relative orientation between electric and magnetic fields is varied, and in the vicinity of the maxima large amplitude conductance oscillations develop with a frequency in the tens of MHz range. The plasma magnetoconductance for given magnitudes of applied fields abruptly drops to zero at a precisely defined orientation between the fields. Author

N68-15629# Princeton Univ., N. J. Frick Chemical Lab.
RELAXATION TIMES AND NORMAL MODE FREQUENCIES
Donald B. Du Pre, J. M. Deutch, and Arthur V. Tobolsky Oct. 1967 8 p refs
(Contract Nonr-1858(07))
(ONR-TR-RLT-100; AD-662253)

A simple relationship between normal mode frequencies and relaxation times known to hold for damped one dimensional solids was proved to obtain in all dimensions. Utilizing this relationship, the solution of the relaxation time distribution function problem reduces to the consideration of normal mode frequency spectrum of the array in question, irregardless of dimensionality. Author (TAB)

N68-15702# Atomic Energy of Canada, Ltd., Chalk River, (Ontario).
THE INTERPRETATION OF A TRANSMISSION ELECTRON DIFFRACTION PATTERN FROM THIN (≤2000Å) ZrO_2 FILMS
R. A. Ploc Nov. 1967 53 p refs
(AECL-2794) Available from Atomic Energy of Canada, Ltd., Chalk River: $1.50

An attempt has been made to determine the mode of ZrO_2 formation on bulk zirconium at 300°C in 760 torr of dry oxygen. Films of $ZrO_2 \leq 2000$Å in thickness were chemically removed from their substrates and studied in transmission in an electron microscope. An interpretation of the Zr/ZrO_2 epitaxy on a Zr (0001) is given. All films contained small oxide crystallites which ranged in size from the detection limit (≈30Å) of the electron microscope to about 250Å. It was suspected that a significant portion of the film was relatively amorphous in regions between crystallites but this could not be experimentally proven. Author

N68-15732# Massachusetts Inst. of Tech., Cambridge. Center for Materials Science and Engineering.
ANNUAL TECHNICAL REPORT, SEPTEMBER 16, 1966–SEPTEMBER 15, 1967
31 Dec. 1967 180 p refs
(Contract ARPA SD-90)
(AD-663181)

Summaries are given of research activities in the following areas: Solid state molecular theory; radiofrequency, microwave and optical spectroscopy of liquids and solids; low-temperature physics; semiconductors and infrared spectroscopy; order-disorder phenomena; crystal and surface structure investigations of metals, zeolites, and other substances by x-ray, neutron and electron diffraction; electric, magnetic and optical properties of materials; semiconductor materials and devices; microwave and quantum magnetics; crystal physics; physics of solids; high temperature metallurgy; electronic materials; superconductive materials; physical metallurgy; martensitic transformations in iron-ruthenium alloys; deformation in iron alloys; strengthening of titanium alloys; fatigue

in titanium alloys; radiation damage in solids; nucleation in nozzles; crystallization and properties of polymers; crystallization and properties of polymers at high pressures; metals processing-casting and solidification; x-ray and electron optics; the relationship between microstructure and mechanical properties of cementitious materials; deformation of alpha iron single crystals. TAB

N68-15849*# Little (Arthur D.), Inc., Cambridge, Mass.
THERMAL CONDUCTIVITY AND DIELECTRIC CONSTANT OF SILICATE MATERIALS, 1 APRIL 1965-31 AUGUST 1966
Alfred E. Wechsler and Ivan Simon Dec. 1966 133 p refs
(Contract NAS8-20076)
(NASA-CR-61495) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Experimental measurements of the complex dielectric constant of glass beads, pumice, and basalt powders, and solid glass, pumice, and basalt were made at wavelengths of 3.2 cm and 1.2 cm over the temperature range from 77°K to 400°K. The thermal conductivity of these materials and quartz powders were measured using the line heat source method at gas pressures of 10^{-8} to 10^{-9} torr and at temperatures ranging from 150°K to 400°K. The dielectric constants of the silicate powders measured vary from 1.9 to 2.9. The dielectric constants of the solid silicates from which the powders were prepared range from 5.4 to 8.6. The effective thermal conductivities of the evacuated powders of particles size 5–75μ vary from about 4×10^{-5} w/cm°C to near 40×10^{-6} w/cm°C over the temperature range from 150°K to 400°K, and can be represented by the sum of a constant term and a term which has a cubic temperature dependence. The ratio of the radiation to solid conduction contributions to effective thermal conductivity varies from less than 0.1 to over 5 depending upon the powder size, composition, and temperature. Author

N68-15883# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE EFFECT OF CRYSTALLOGRAPHIC ORIENTATION OF THE GEOMETRY OF A FUSED P–N JUNCTION IN GALLIUM ARSENIDE [VLIYANIYE KRISTALLOGRAFICHESKOY ORIYENTATSII NA GEOMETRIYU VPLAVLENNOGO P–N-PEREKHODA V ARSENIDE GALLIYA]
O. I. Pavlova and R. L. Petrusevich 3 Aug. 1967 9 p refs
Transl. into ENGLISH from Gos. Nauchn.-Issled. i Proyektnyy Inst. Obrabotki-Isvetnykh Metallov. Sb. Nauchn. Tr. (Moscow), no. 24, 1965 p 54–56
(FTD-HT-23-553-67; AD-662839)

The effect of crystallographic orientation on the shape of fused p-n transition boundaries was studied in p-type gallium arsenide. The results showed that for melting on surfaces with (110) and (100) orientations the p-n-interface did not have a regular geometrical shape even for very small drops. Reference was made to the work of Ellis (J. Appl. Phys., 1959, v. 30, no. 6, p. 946) where gallium arsenide was grown on vertical (110) surfaces of seed crystals. TAB

N68-15975*# Pennsylvania State Univ., University Park. Materials Research Lab.
APPLICATIONS OF LUMINESCENCE TECHNIQUES TO THE STUDY OF THE LUNAR SURFACE
Raymond T. Greer, Vladimir Vand, and Jon. N. Weber 1968 31 p refs Presented at Symp. on the Interpretation of Lunar Probe Data-2, Huntington Beach, Calif., 26 Jan. 1968
(Grant NGR-39-009-015)
(NASA-CR-92508) CFSTI: HC $3.00/MF $0.65 CSCL 20L

Optical fluorescence spectra was used to nondestructively analyze rock-forming minerals to obtain information on both macroscopic and microscopic polymineralic assemblages. Specific applications to the types and sizes of lunar and planetary materials anticipated, both on the surface and those which will eventually be available to the terrestrial laboratory, were chosen to represent and to demonstrate how the complexities of the luminescent phenomena can be beneficial. The variations in color and intensity of the luminescent response facilitate positive identification of mineral grains, singly or in bulk rock specimens, when a particular color (single or multiple emission band) is associated with the mineral or phase whose luminescent properties are evaluated. L.S.

N68-15981# State Univ. of New York, Stony Brook. Dept. of Materials Science.
GALVANOMAGNETIC EFFECTS IN ANTIMONY
K. Tanaka, S. K. Suri, and A. L. Jain Nov. 1967 19 p refs Submitted for publication
(Contract N00016-66-C-0194)
(TR-2; AD-662025)

The galvanomagnetic effects in antimony was measured at low magnetic fields in the temperature range 50-300K. It is shown that the behavior of the resistivity and the Hall coefficients at low temperatures is in qualitative agreement with the model of two overlapping bands as proposed by Windmiller and Falicov and Lin. However the initial increase in the Hall coefficient rho sub 23.1 with temperature indicates the possibility of another hole band with the band edge lying close to the Fermi level. Author (TAB)

N68-15986# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.
DEPARTMENT OF ELECTRONICS
Witold Rosinski *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 37–68 refs (See N68-15982 06-34)

Semiconductor materials and devices were investigated and their properties were measured. Technologies and problems encountered in fabricating thin semiconductor layers are reported. Descriptions are given of the application of the thin layers to varactors, p-n heterojunctions, lasers, and Hall effect devices. Electric and noise properties were determined, and emphasis was placed on the measurement of impurity distribution. A transistorized meter, developed for measuring electric properties, is described. N.E.N.

N68-15989# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.
DEPARTMENT OF MAGNETICS
Adam Smolinski *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 69–75 refs (See N68-15982 06-34)

Continuing theoretical and experimental research on ferrites, magnetic subassemblies, microwave quantum amplifiers, and thin magnetic films is reported. The domain structures in uniaxial magnetic materials and the structure defects in monocrystals of ruby were investigated. Ferrite monocrystal production and magnetostrictive properties of ferrites are mentioned. An isolator and a broadband circulator, both for operation in S-band, were developed. Work in quantum electronics centered on the optimization of the parameters of high temperature masers, and research on magnetic films emphasized the applications of thin film elements in digital computers. N.E.N.

N68-16058# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.
POLARIZATION GRADIENT IN ELASTIC DIELECTRICS
R. D. Mindlin Oct. 1967 14 p refs
(Contract Nonr-4259(13))
(TR-7; AD-662683)

By inclusion of the polarization gradient in the stored energy function of elastic dielectrics, the classical theory of piezoelectricity is extended to accomodate an electro-mechanical interaction in centrosymmetric (including isotropic) materials and a surface energy of deformation and polarization. Author (TAB)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N68-15548# Bureau of Mines, Bartlesville, Okla. Petroleum Research Center.

STORAGE STABILITY OF GASOLINE—COMPARISON OF STORAGE AND RAPID BOMB AGING

Charles Simar Allbright, Frank G. Schwartz, and Cecil C. Ward Feb. 1968 36 p refs Sponsored in part by Army

(BM-RI-7084)

To develop a method for predicting the stability of a fuel during long-term storage from rapid aging tests at 200°F, the Bureau of Mines determined the stabilities of three gasoline base stocks and an alkylate blending stock in both sealed storage and aerated storage at 110°F for periods extending to 32 weeks. Stabilities of samples containing gasoline-additive compounds were compared by aging, using two methods—rapid aging in a bomb at 200°F for intervals up to 16 hours and storage at 110°F. The additives used were an uninhibited tetraethyllead motor mix, N,N'-di-sec-butyl-p-phenylenediamine and 2, 6-di-tert-butyl-4-methylphenol. Results were related by graphs that enable predictions of gum and sediment formation during storage from data obtained in bomb tests. A premium-gasoline base stock and the alkylate proved to be stable, but the two regular-grade gasoline base stocks were found to be unstable. Addition to the diamine antioxidant improved the stability of both of the regular gasoline base stocks, while the phenol antioxidant improved only one of them. The presence of the tetraethyllead decreased the storage stability of all four fuels, both with respect to formation of gum and precipitation of inorganic sediment. The rapid test at 200°F appears to offer promise as a basis for a method of predicting gasoline stability in long-term 110°F storage. Author

N68-15698*# Douglas Aircraft Co., Inc., Santa Monica, Calif. Missile and Space Systems Div.

HYPERGOLICITY OF F_2–H_2 AND REACTION PRODUCT FREEZING UNDER MAIN TANK INJECTION PRESSURIZATION CONDITIONS Interim Report, 30 Jun. 1966–30 Jul. 1967

E. C. Cady 15 Sep. 1967 106 p refs

(Contract NAS3-7963)

(NASA-CR-72253; DAC-60975) CFSTI: HC $3.00/MF $0.65 CSCL 21I

An experimental program is described which determined the effects of physical and chemical variables on the hypergolicity of F_2–H_2 under conditions relevant to Main Tank Injection pressurization of the LH_2 tank. A concurrent program describes the characteristics of reacted HF and unreacted F_2 freezing in the LH_2 tank. Testing was done in small (5-in. diam) glass Dewars. Generally, hypergolic ignition was found with some variables inhibiting the reaction to a point of nonignition and freezing of the F_2. Several injection modes were tested, and criteria for reliable ignition and effective pressure rise were determined. Author

N68-15824*# General Dynamics/Fort Worth, Tex.

AN ANALYTICAL STUDY OF STORAGE OF LIQUID HYDROGEN PROPELLANT FOR NUCLEAR INTERPLANETARY SPACECRAFT Quarterly Progress Report, 30 Jun.–30 Sep. 1967

D. G. Barry 15 Oct. 1967 30 p refs

(Contract NAS8-21080)

(NASA-CR-92537; FPR-034; QPR-1) CFSTI: HC $3.00/MF $0.65 CSCL 21I

To assess the problem of extended earth orbital storage of liquid hydrogen propellant for a conjunction-class manned Mars vehicle, preliminary parametric analyses were undertaken to determine the insulation thermal conductivity–density product, the Mars orbit altitude, and the type of thermal management system. The mission is defined as a manned Mars stopover with a total duration of 1020 to 1200 days, depending upon the earth orbital staytime. Effort was also devoted to determining the mass variation with altitude of the Mars excursion module. Structural analysis was directed toward assessing the tank pressure mass relationship and the meteoroid protection criteria. The basic structural concept is the load-carrying shell module in which the shell is jettisoned just prior to earth departure. Baseline vehicle data are summarized, and the initial mass in earth orbit approach is used to evaluate the various thermal management systems. A tank thermal model is defined for evaluating the thermal environment and establishing the vent pressure for the vented thermal management systems. M.G.J.

N68-16051*# Aerojet-General Corp., Sacramento, Calif.

MOTOR 260-SL-3 PROGRAM. VOLUME 2: 260-SL-3 MOTOR PROPELLANT DEVELOPMENT Final Phase Report

14 Jul. 1967 108 p

(Contract NAS3-7998)

(NASA-CR-72282; AGC-7096) CFSTI: HC $3.00/MF $0.65 CSCL 21I

To define the propellant formulation requirements of Motor 260-SL-3, a propellant tailoring program was conducted to select the burning additive type and concentration, and oxidizer blend, and the plasticizer concentration. Two binder systems, with and without anhydride, were evaluated, and the reasons for selecting the anhydride-free propellant (ANG-3254) for casting the motor are given. Processing methods are described, along with the mechanical properties characterization tests which were conducted to provide engineering data for comparing the mechanical properties of ANB-3254 with the stress analysis of the motor grain design. Motor processing is discussed in terms of the preparation of invert slivers, liner application, and casting. The data indicate that the ANB-3254 formulation exhibits adequate mechanical and bonding properties margins compared to the calculated structural requirements for the 260-in. diameter motor grain. M.G.J.

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N68-15039# Technische Hochschule Hannover (West Germany).
EFFECTS OF NOZZLE GEOMETRY ON JET FLOW EJECTORS [AUSWIRKUNGEN DER TREIBDUESENFORM BEI GASSTRAHLAPPARATEN]
Erich Barth (Ph.D. Thesis) 1966 85 p refs In GERMAN

The effects of nozzle geometry on jet exhaust and performance of supersonic axial flow turbines was determined by using impulse flow equations to obtain the performance efficiency of the exhaust thrust. Calculation on a mixed flow in a pressure tube showed that the observed turbulent mixing zone increased with larger exhaust diameter; the pressure increased close to the ejector but did not improve the thrust of jet. Transl. by G.G.

N68-15123 Technische Hochschule Hannover (West Germany).
THE INFLUENCE OF RADIAL BLADE GAPS ON THE MECHANICAL EFFICIENCY OF MULTI-STAGE TURBINES [DER EINFLUSS DES RADIALEN SCHAUFELSPALTES AUF DEN WIRKUNGSGRAD MEHRSTUFIGER TURBINEN]
Dietrich Hartmann (Ph.D. Thesis) 1967 137 p refs In GERMAN

The losses at the radial gap between the rotating blades and the turbine housing were measured on a straight grid with gap and on an experimental air turbine with from one to seven blade stages. Gap widths, mass flow, and rpm were varied during the tests. The straight grid experiments served to measure the effects of grid geometry on flow processes. A generally applicable equation for gap losses was derived from the straight grid experiments. The calculated results were compared with those obtained by investigators using other equations as well as with the values obtained on the experimental turbine. Transl. by K.W.

N68-15130 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AIRCRAFT ENGINES [AVIATSIONNYYE DVIGATELI]
V. A. Tyutyunov and S. I. Lovinskiy 1 May 1967 293 p refs Transl. into ENGLISH from the book "Aviatsionnyye Dvigateli" Moscow, 1964 p 19–55, 58–65, 71–169, 180-310, and 354–365 (FTD-MT-65-212; AD-662481)

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3. THE THEORY OF JET ENGINES V. A. Tyutyunov and S. I. Lovinskiy p 49–279 refs (See N68-15133 06-28)

N68-15131 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
FUNDAMENTALS OF ENGINEERING THERMODYNAMICS
V. A. Tyutyunov and S. I. Lovinskiy *In its* Aircraft Engines 1 May 1967 p 1–38 (See N68-15130 06-28)

Consideration is given to basic gas laws and to processes in a study of fundamental engineering thermodynamics relative to aircraft engine design. The concept of ideal and real gases are discussed along with the gas parameters of pressure, temperature, and specific volume and density. The Boyle-Mariotte law, the Gay–Lussac law, the ideal gas law, gas heat capacity, and the first law of thermodynamics are briefly discussed. Included are discussions of isochoric, isobaric, isothermal, adiabatic, and polytropic processes. C.T.C.

N68-15132 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
AVIATION FUELS AND OILS: FUEL COMBUSTION
V. A. Tyutyunov and S. I. Lovinskiy *In its* Aircraft Engines 1 May 1967 p 39–48 (See N68-15130 06-28)

A fundamental discussion is presented of refining processes for aviation fuels and oils, requirements of jet and piston engine fuels, propellants for liquid rocket engines, and requirements of aviation oils. C.T.C.

N68-15133 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE THEORY OF JET ENGINES
V. A. Tyutyunov and S. I. Lovinskiy *In its* Aircraft Engines 1 May 1967 p 49–279 refs (See N68-15130 06-28)

The theory and operating principles of turbojet, turboprop, ramjet, and gas turbine engines are briefly presented. Consideration is given to compressors, combustion chambers, exhaust units, afterburners, power systems, lubrication, fuel supply systems, starting, reduction gears, and carburetion. General information on the design of main engine components such as cylinders, pistons, connecting rods, and crankshafts is included. C.T.C.

N68-15158 Rolls-Royce Ltd., Littleover (England).
THE DESIGN AND MANUFACTURE OF A LIQUID HYDROGEN THRUST CHAMBER
T. E. Steer 1967 24 p refs Presented at ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 and at Brit. Interplanet. Soc. Meeting, London, 2–3 Nov. 1967 Submitted for publication
(ELDO-SP-67-5) CFSTI: HC $3.00/MF $0.65

Summarizes the design and manufacture of a Rolls-Royce liquid hydrogen–liquid oxygen thrust chamber producing 70 kN of thrust in vacuo. The chamber design is based on an engine study carried out in collaboration with SEPR, which led to the receipt of contract from ELDO to manufacture two experimental versions of this chamber. The performance of the chamber and the heat transfer and stress analysis leading to the final design of tubular combustion chamber are described, together with the design of the shell reinforcing the tubular jacket, the film cooled nozzle extension, the injectors and ignition system. The manufacture of the two chambers is still at an early stage, but some of the manufacturing problems encountered are described and their solutions outlined. Author (ESRO)

N68-15168*# Aerojet-General Corp., Secramento, Calif.
260-SL-3 MOTOR PROGRAM Final Report
31 Jul. 1967 74 p refs
(Contract NAS3-7998)
(NASA-CR-72289) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Design, fabrication, and test firing data are presented on a 260-in.-dia. solid rocket engine which was designed to enable maximum evaluation of component performance at minimum cost. The significant design features of each major element of the motor are summarized. A program plan is presented, along with a reliability and quality assurance program. Test firing, results demonstrated the adequacy of design concepts and materials and fabrication techniques selected for ablative nozzles. Further confirmation of design adequacy, and material and fabrication process selection for the chamber, insulation, and igniter system were also provided. B.S.D.

N68-15416# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF CERTAIN GEOMETRIC PARAMETERS OF TURBINE GRIDS [OPREDELENIYE NEKOTOR YKH GEOMETRICHESKIKH PARAMETROV TURBINNYKH RESHETOK]

B. M. Aronov 30 Aug. 1967 15 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (Kazan), no. 4, 1965 p 109–117

(FTD-HT-66-535; AD-662461)

The use of electronic computers instead of graphic methods for turbine blade calculation requires preliminary determination of the geometric parameters. To determine the dependence of these parameters on other known turbine blade characteristics, measurements were made of a series of blade cascades of various types of aircraft turbine engines. Formulas were derived for maximum blade thickness, blade profile area, inlet edge radius, inlet and exit angles, and blade angle. The interrelationship of geometric parameters was found to be the same for both nozzle and rotor blade cascades. TAB

N68-15417# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

TURBINE STAGE CHARACTERISTICS [KHARAKTERISTIKI TURBINNOY STUPENI]

D. A. Dekhovich 18 Aug. 1967 21 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Energ. (Minsk), no. 8, 1965 p 67–75

(FTD-HT-66-537; AD-662459)

The working lines of a turbine stage, formulated on a working characteristics diagram, allow evaluation of flow conditions in a nozzle and in working rims by the number lambda, to establish the change in degree of reactance in dependence upon the pressure ratio sigma and relative circumferential velocity nu (or lambda sub u1) and formulate universal characteristics of an axial and radial turbine. At a reduction alpha 1 in a turbine with rotating nozzle blades takes place a considerable displacement or working lines in the area of low reactance, and increase in alpha 1, it displaces the system of working lines into the zone of high reactivity. In the reactive axial stage of the turbine the reactance substantially depends upon the pressure ratios, the effect of circumferential velocity on rho is weakened. With a rise in pressure ratios the working lines approach close and at high sigma they may intersect. At a change in circumferential velocity in a radial centripetal turbine sharply change the reactance degree, the pressure ratio sigma has a weaker effect on rho. Author (TAB)

N68-15453*# Colorado State Univ., Fort Collins. Coll. of Engineering.

ADVANCED ELECTRIC PROPULSION RESEARCH Annual Report, 1 Jan.–31 Dec. 1967

William R. Mickelsen Dec. 1967 89 p refs

(Grant NGR-06-002-032)

(NASA-CR-92560; MER-67-68WRM-9; Rept.-6) CFSTI: HC $3.00/MF$0.65 CSCL 21C

A definite need exists for approximate, simple, fast and flexible methods for preliminary analysis of electric propulsion missions. Methods are presented which serve these ends, and provide a straightforward technique for the determination of the effects of system components of mission performance. These approximate techniques utilize a combination of existing trajectory and mission analysis techniques, such as impulsive thrust analysis, characteristic length, and low-thrust mission characteristics. Practical constraints associated with electric propulsion systems are included throughout the analysis. These methods have been compared with more exact solutions of the Mars orbiter-lander and the Jupiter fly-by missions. Power profiles from more exact solutions, linearized profiles, and profiles deduced from impulsive-thrust trajectories, were used as inputs to the approximate analysis. The approximate methods provided final mass fractions within about ten percent of the more exact analyses. The good results obtained with the approximate methods in a wide variety of mission profiles has established confidence in the approximate methods. It appears that these methods can be used for preliminary screening of mission profiles, to be followed by the more exact analyses. Author

N68-15520# Bolkow Entwicklungen K. G., Munich (West Germany).

HIGH ENERGY ROCKET ENGINES WITH FLUORINE PROPELLANTS STATE OF THE ART, POSSIBLE APPLICATIONS

H. Krebs 27 May 1966 43 p refs Presented at the European Space Vehicle Launcher Develop. Organ. Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication

(TR-666-O; ELDO/SP(67)9) CFSTI: HC $3.00/MF $0.65

A summary is given of the state of the art of high-energy propulsion systems, in particular of fluorine propellants and engines. The importance and advantages of fluorine engines are shown and comparisons are made with the high-energy propellant combination hydrogen/oxygen. The difficulties encountered with fluorine propellants and engines are also pointed out. The possible applications of fluorine engines are indicated. In conclusion the preliminary practical work done at Bolkow for the development of fluorine engines is described briefly including the engine tests using both gaseous and liquid fluorine which have been carried out so far. Author (ESRO)

N68-15644*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

COMBUSTION IN STABILITY IN STEEL AND ABLATIVE ROCKET CHAMBERS

Ralph R. Goetz Washington Feb. 1968 11 p refs

(NASA-TM-X-1511) CFSTI: HC$3.00/MF$0.65 CSCL 21B

An investigation was conducted to compare the effects of ablative chambers and steel chambers on combustion instability in a hydrogen-oxygen rocket engine. Both uncharred and charred ablative materials were evaluated. Two concentric tube injectors were used for the testing at a chamber pressure of 300 psia (2070 kN/m^2) and a nominal thrust of 20,000 pounds (89 kN). Hydrogen-injection temperature ramping was the basic stability rating technique. An instability amplitude comparison analysis was completed to detect amplitude variations for the two materials. Both the hydrogen-injection temperature ramping and the amplitude analysis lead to the same conclusion: There is no significant difference in stability limit or instability amplitude between the steel, charred ablative, and uncharred ablative chambers. Author

N68-15861*# Aerojet-General Corp., Sacramento, Calif. Liquid Rocket Operations.

DEVELOPMENT OF A 1,500,000-LB-THRUST (NOMINAL VACUUM) LIQUID HYDROGEN/LIQUID OXYGEN ENGINE Final Report, 30 Apr. 1962–4 Aug. 1966

30 Aug. 1967 381 p refs

(Contract NAS3-2555)

(NASA-CR-91903; Rept.-2555-M-I-F) CFSTI: HC $3.00/MF $0.65 CSCL 21H

The M-1 engine configuration is one of opposed oxidizer and fuel turbopumps fed by two 19-in. suction lines located 180 degrees apart. The turbopumps are supported by tubular members with primary attachment points on thrust chamber injector flange and fuel distribution torus. Use of these support locations reduces engine weight but compromises thrust chamber design due to imposition of high unit loads. A major factor in the M-1 engine

design was dynamic load predictions. A conservative extrapolation of Titan, F-1, and J-2 engine data was applied. This resulted in signficant dyanmic loads; in some cases equivalent to 6 g's of static load. Detailed descriptions are given of all phases of engine development including: system components, ground support equipment, program support requirements, quality control and reliability, special test equipment, fabrication, hydrogen heat transfer facility, general support facilities, engine materials, controls, and specifications. E.C.

N68-15897# Bolkow Entwicklungen K. G., Munich (West Germany).
DESIGN CRITERIA FOR HIGH-PRESSURE ROCKET ENGINES
Michael Kaufmann [1967] 42 p ref Presented at the European Space Vehicle Launcher Develop. Organ. Symp. on Propulsion, Paris, 10–12 Oct. 1967
(TR-671-0) CFSTI: HC $3.00/MF $0.65

Discusses influence of complete combustion and overall efficiency of the propellant feed system on the design of high pressure rocket engines. Illustrates how maximum specific impulse can be achieved from a thermodynamic analysis of a topping cycle rocket engine with precombustion and regenerative cooling, using a LO2/LH2 rocket engine of 10,000 kp thrust. Computed performances indicate that the highest feasible chamber pressure can be determined by trading off thermodynamic gain against technological problems, and the remaining primary engine data deduced. The dividing line between high-pressure and low-pressure engines is defined. Author (ESRO)

N68-15898# Bombrini Parodi-Delfino S. P. A., Rome (Italy).
SOLID PROPELLANT ENGINES PROBLEMS CONCERNING ELDO PROGRAMMES
G. Marega [1967] 13 p Presented at the European Space Vehicle Launcher Develop. Organ. Symp. on Propulsion, Paris, 10–12 Oct. 1967
(ELDO/SP(67)10) CFSTI: HC $3.00/MF $0.65

Reviews problems in the design of solid propellant rocket engines with particular reference to the BPD designs for the ELDO-PAS apogee motors. Discusses also the use of advanced materials in the design of a motor with an improved mass ratio and mentions a feasibility study carried out by H.S.D. and BPD for improving the performance of the ELDO A vehicle, means of solid propellant strap-on boosters. ESRO

N68-15939# Societe d'Etude de la Propulsion par Reaction, Villejuif (France).
THE DEVELOPMENT OF THE S.E.P.R. HM4 ENGINE: A 40 KN THRUST LIQUID OXYGEN AND HYDROGEN ENGINE [DEVELOPPEMENT D'UN MOTEUR S.E.P.R. HM4 A OXYGENE ET HYDROGENE LIQUIDES DE 40 KN DE POUSSEE]
J. Dardare 12 Oct. 1967 19 p In FRENCH; ENGLISH summary Presented at the ELDO Symp. on Propulsion, Paris, 10–12 Oct. 1967 Submitted for publication
CFSTI: HC $3.00/MF $0.65

Describes a liquid hydrogen/liquid oxygen rocket motor of 40 kN thrust with a tubular thrust chamber is being developed to increase the performance of the French Diogene launch vehicle. Principal stages in its development and the testing facilities employed are discussed. Author (ESRO)

N68-16024* Aerojet-General Corp., Sacramento, Calif.
TWO HUNDRED SIXTY SL-3 MOTOR PROGRAM. VOLUME 3: 260-SL-3 MOTOR NOZZLE AND EXIT CONE DESIGN, FABRICATION AND ASSEMBLY Final Phase Report
14 Jun. 1967 177 p
(Contract NAS3-7998)
(NASA-CR-72283) CFSTI: $3.00 CSCL 21H

The design and analysis, component fabrication, and assembly operations, of the nozzle and exit cone for Motor 260-SL-3 are described. The assemblies were shipped to the motor test firing site. The nozzle design was identical in throat size and entrance contour to a submerged omnivector movable nozzle for the full-length motor. The nozzle consists of three primary elements: the structure, ablatives, and insulation. The structure consists of the nozzle shell, fabricated from 18% nickel maraging steel; the entrance rig, fabricated from AISI 4130 steel; and the exit cone, fabricated from composite glass cloth/roving with epoxy resin and steel end flanges. The ablative elements including the submerged insert, nose insert, entrance insert, throat insert, throat extension insert, and the exit cone liner were all fabricated from Fiberite MX-4926 phenolic resin-impregnated carbon cloth. Gen-Gard V-44 rubber insulation was used on the surface of the nozzle shell and entrance ring. L.S.

N68-16053*# Aerojet-General Corp., Sacramento, Calif.
TWO HUNDRED SIXTY SL-3 MOTOR PROGRAM. VOLUME 4: STATIC TEST FIRING OF MOTOR 260-SL-3 Final Report
31 Jul. 1967 182 p refs
(Contract NAS3-7998)
(NASA-CR-72284) CFSTI: HC $3.00/MF $0.65 CSCL 21H

Static test firings were conducted to verify the design concepts, fabrication techniques, materials suitability, and processing procedures for large solid rocket motors, and to demonstrate the suitability of a polybutadiene propellant formulation for attaining a burning rate of approximately 0.71 in. sec. The results indicate: (1) The ignition transient of Motor 260-SL-3 was close to that predicted. The aft-end ignition motor operated as designed; all ignition parameters were within design limits. (2) Ballistic data show that the nozzle expansion ratio was reduced from 3.8 to about 2.5 during the pressure surge that started at 66.18 sec. Excessive loads caused by the propellant ejection apparently produced a structural failure of the exit cone and the simultaneous ejection of the aft portion. (3) Erosion of the nozzle ablative inserts was close to predicted values. It was concluded that the test firing data demonstrated the feasibility of large solid rocket motors, and confirmed the adequacy of ablative nozzle design concepts and fabrication techniques in the configurations proposed for thrust vector control systems. M.G.J.

N68-16054*# National Aeronautics and Space Administration, Washington, D. C.
ROCKET PROPULSION
1967 4 p ref
(NASA Facts-S-1/8-67) GPO: $0.05 CSCL 21H

Rocket propulsion is briefly described, suitable for junior or senior high school use. The propulsion system for liquid and solid propellants are discussed, and the problems involved with each are identified. The Apollo/Saturn V is diagrammed, and the liquid and solid propellant rocket engines and storage tanks are indicated. N.E.N.

N68-16067*# Avco Corp., Lowell, Mass. Space Systems Div.
MAGNETOPLASMADYNAMIC THRUSTOR RESEARCH Final Report
S. Bennett, G. Enos, R. John, and W. Powers 21 May 1967 148 p refs
(Contract NAS3-8907)
(NASA-CR-72345; AVSSD-0272-67-RR) CFSTI: HC $3.00/MF $0.65 CSCL 21C

Radiation- and water-cooled MPD thrustors were operated in a range of power of 10 to 100 kilowatts, in the I_{sp} range 1000 to 5000 seconds, using ammonia as the propellant. Parametric studies were made of the effects of configuration, field strength, ambient pressure, propellant composition, and current on performance. A life test was made of a radiation-cooled thrustor at the 3000 second, 36 kilowatt level. Author

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N68-15025# Max-Planck-Institute fur Physik und Astrophysik, Munich (West Germany). Institut fuer Extraterrestrische Physik.
THE SOLAR WIND: THEORY, RESULTS OF MEASUREMENT, PROBLEMS OF MEASUREMENT [DER SOLARE WIND; THEORIEN, MESSERGEBNISSE, MESSPROBLEME]
H. Rosenbauer 1967 10 p refs In GERMAN Presented at the DGRR Symp., Munich, 7 Dec. 1967

The review of the solar wind theory is chiefly based on the current stand of particle measurements in the undisturbed regions. Magnetic field measurements and observations of the interaction between solar wind and the magnetosphere are also briefly discussed. Considered are: (1) the need for direct measurements outside of the ecliptic and at lesser and greater distances from the sun; (2) the temporal and angular resolutions of present measuring methods; (3) the simultaneous use of several probes to determine the spatial structure of solar plasmas; and (4) mass spectrometry to study the presence of alpha particles in the solar wind. A discussion of instrument improvement covers ac, dc, and charge measurements; particle counting and the use of multipliers, channeltrons, scintillation counters, Geiger counters, and semiconductor detectors; plasma cups; and electrostatic analyzers. Transl. by K.W.

N68-15050# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
COSMIC RAYS, NO. 8 [KOSMICHESKIE LUCHI, NO. 8]
1967 325 p refs In RUSSIAN; ENGLISH summaries

Articles on solar-diurnal variations, the 11-year and 27-day variations, meteorological effects, geomagnetic field influence, solar cosmic rays, experimental methods, and methods and theory of cosmic ray variations are presented. For individual titles see N68-15051–N68-15083.

N68-15051# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE STATISTICAL ANALYSIS OF THE SOLAR-DIURNAL COSMIC RAY VARIATION ACCORDING TO THE DATA OF DIRECTED TELESCOPES AND NEUTRON MONITORS
M. V. Alania, L. I. Dorman, V. K. Koiava, L. G. Osepaishvili, and O. G. Rogava *In its* Cosmic Rays, No. 8 1967 p 14–18 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

The correlation of the amplitudes and phases of the first harmonic of the solar-diurnal variation for various stations is studied according to the data on the cosmic ray neutron component from the worldwide network of stations. The analysis has shown that a good correlation for the phase and amplitude is observed for the pairs of stations located at the same longitude. A bad correlation for the phase is noted for the pairs of stations located far from one another in longitude. Besides that, the behavior of the phases and amplitudes of the first harmonic is studied according to the data of the directed telescopes of Itabashi station for 1958. The analysis has shown that the source of the diurnal variation for high energies changes mostly in the directions and is not disturbed. The analysis of the source of the diurnal variation anisotropy indicates the simultaneous existence of two sources of the solar-diurnal variation rotating in the opposite directions. Author

N68-15052# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE SOLAR-DIRUNAL COSMIC RAY VARIATION IN JULY, 1959
L. I. Dorman and A. M. Chkhetia *In its* Cosmic Rays, No. 8 1967 p 19–34 refs (See N68-15050 06-29)

The solar-diurnal variation of the cosmic ray in July, 1959 is studied. The contribution of the temperature effect of the μ-meson component to the observed solar-diurnal variation is analyzed in detail. Author

N68-15053# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE DIURNAL VARIATION OF COSMIC RAY HARD COMPONENT NEAR THE SOLAR MINIMUM
K. K. Fedchenko *In its* Cosmic Rays, No. 8 1967 p 35–39 refs (See N68-15050 06-29)

The diurnal cosmic ray variation and the features of its behavior near the solar minimum in 1954 is studied according to the data of the cosmic ray rigid component observations from the Tukhaya Bay station using a shielded ionization chamber. The diurnal variation of the meteorological origin is determined with the help of the radiosonde data and using the Feinberg–Dorman method. The exclusion of this variation from the observed one makes it possible to find the true diurnal variation of the exospheric origin. Author

N68-15054# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE DIURNAL AND HALF-DIURNAL COSMIC RAY INTENSITY VARIATIONS IN CONNECTION WITH MAGNETIC AND SOLAR ACTIVITY
M. V. Alania and L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 40–51 refs (See N68-15050 06-29)

The solar-diurnal and half-diurnal variations of the cosmic ray neutron component are investigated according to the observation data from Climax and Norikura stations for the period of 1957–1964. The half-diurnal variation was studied separately for the sunlit and night sides of the earth. It has been shown that the unambiguous connection between the changes in the geomagnetic field perturbations and in the amplitude of the first harmonic of the solar diurnal variation does not exist. It has been found that the correlation coefficient between the amplitudes of the harmonic at Climax and Norikura stations decreases as the geomagnetic field perturbation increases, which testifies to the increase of the contribution of the local source of the diurnal variation. The amplitude of the half-diurnal variation at the earth's sunlit side has been found to be monotonically increased with decreasing solar activity. Author

N68-15055# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE DISTRIBUTION OF THE FREQUENCY OF SUDDEN CHANGES IN THE COSMIC RAY INTENSITY AND THE SOLAR-DIURNAL VARIATION

M. V. Alania, L. I. Dorman, and L. Kh. Shatashvili *In its* Cosmic Rays, No. 8 1967 p 52–64 refs (See N68-15050 06-29)

The changes in the frequency distribution of the sudden cosmic ray variations are studied in connection with the changes in the solar activity. Besides that, the seasonal variation of this distribution and the connection of the sudden intensity changes with the solar-diurnal variations are studied. The following main conclusions are presented: (1) It has been found that the frequency maximum of the sudden increases in the cosmic ray neutron component intensity at Climax is observed on the average at about 12 hours, and at Norikura at about 10 hours of the local time. (2) It has been established that the phase of the diurnal frequency distribution of the sudden increases depends significantly upon a season. (3) The analysis of the observation data made with the help of a neutron supermonitor also shows the presence of the pronounced maximum of the frequency distribution of the sudden increases at about 12 hours of the local time. (4) It has been established that when the relatively great amplitudes of the sudden changes in the cosmic ray neutron component disappear the cosmic ray anisotropy spectrum becomes harder. Author

N68-15056# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE EXPERIMENTAL DATA FOR THE 11-YEAR VARIATIONS AND THE MECHANISMS OF THE INTEGRAL MODULATION OF THE GALACTIC COSMIC RAYS IN INTERPLANETARY SPACE

I. V. Dorman and L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 65–72 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

The energy characteristics of the 11-year cosmic ray variations are determined. The electromagnetic conditions in the interplanetary space are evaluated, and the dimensions of the modulation region are determined on the basis of the spherically symmetrical dynamical model of the 11-year variation. The expected variations in the region of various energies are analyzed for the protons, α-particles, and electrons of the galactic cosmic rays. The spectrum of the cosmic ray rigidities outside the modulation region beyond the solar system is determined. It has been shown that a considerable part of the spectrum bending is due to the modulation in the interplanetary space. Other possible causes of the spectrum blending are also discussed. The expected gradient of the cosmic ray intensity in the interplanetary space depending upon Z and particle rigidity are evaluated according to the modulation parameter. The obtained results bearing on the gradient are in agreement with the Mariner 2 measurement data. Author

N68-15057# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON THE 27-DAY VARIATIONS IN THE PHENOMENA OF ELECTROMAGNETIC COMPLEX FOR THE PERIOD WITH VERY WELL EXPRESSED SUN'S ROTATION EFFECT IN COSMIC RAYS

L. I. Dorman, A. M. Chkhetia, and L. Kh. Shatashvili *In its* Cosmic Rays, No. 8 1967 p 73–83 refs (See N68-15050 06-29)

The tendency toward the 27-day recurrence in the cosmic rays and the connection of this recurrence with the corresponding variations in the solar and magnetic activity are studied. Author

N68-15058# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE 27-DAY VARIATION OF COSMIC RAYS AND THE EFFECTIVE VOLUME RADIUS OF THE MAGNETIC INHOMOGENEITY ASYMMETRIC SOLAR WIND

M. V. Alania, L. I. Dorman, and L. Kh. Shatashvili *In its* Cosmic Rays, No. 8 1967 p 84–87 refs (See N68-15050 06-29)

The 27-day cosmic ray neutron component intensity variations have been studied according to the observation data from Norikura and Climax stations for the period of July 1957 to June 1953. The results of the harmonic analysis with the 27-day period were compared with similar data for the sunspot number. The correlation coefficients have been found between the amplitudes of the first harmonic for the cosmic ray intensity and for the sunspot number as a function of the solar activity levels. It has been shown that the highest values of the correlation coefficient are reached in the case of the definite lag of the cosmic ray intensity changes with respect to the changes in the sunspot number. Author

N68-15059# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE INFLUENCE OF CHANGES IN THE EARTH'S HELIOLATITUDE UPON THE COSMIC RAY INTENSITY IN 1963–1964 AND THE EVALUATION OF THE COSMIC RAY INTENSITY GRADIENT PERPENDICULAR TO THE ECLIPTIC PLANE

L. I. Dorman and S. Fisher *In its* Cosmic Rays, No. 8 1967 p 88–99 refs (See N68-15050 06-29)

In the case when the cosmic ray intensity gradient perpendicular to the plane of the solar equator is present the intensity modulation must appear due to the inclination of the ecliptic plane to the plane of the solar equator. This report considers various possible versions of such a modulation, and a comparison is made with the observation data from 11 cosmic ray stations in 1963–1964. It has been shown that two regions of decreased intensity corresponding to the active regions in the Northern and Southern Hemispheres of the sun existed during this period near the solar equator. A possible distortion of the modulation caused by the superposition of the yearly wave in the presence of the radial gradient of the intensity (because of the ellipticity of the earth's orbit) has been considered, and the intensity gradient perpendicular to the solar equator plane has been evaluated. Author

N68-15060# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON THE NATURE OF THE LAG OF THE COSMIC RAY INTENSITY CHANGES WITH RESPECT TO THE SOLAR ACTIVITY CHANGES

I. V. Dorman and L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 100–109 refs (See N68-15050 06-29)

The hysteresis event in the character of the connection of the 11-year cosmic ray variation with the solar activity is studied according to the observations from the ground stations of the continuous detection of the cosmic ray intensity. It is shown that the main features of this event may be understood within the framework of the elementary model taking account of the lag of the measurements of the electromagnetic conditions in the interplanetary space with respect to the changes in the solar atmosphere conditions. This lag is assumed to be proportional to the distance to the sun with the proportionality constant being equal to the solar wind velocity.) In this case the best agreement with the experiment in the period of high solar activity is reached at $r_0/u = 20$ months which corresponds to the modulation region radius $r_0 = 100$ a. u. for the solar wind velocity $u = 3 \cdot 10^7$ cm/sec. The interpretation of the obtained results is given. Author

N68-15061# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ON THE NEUTRON COMPONENT TEMPERATURE EFFECT

N. S. Kaminer, S. F. Ilgatch, and T. S. Khadakhanova *In its* Cosmic Rays, No. 8 1967 p 110–112 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

A method is proposed for studying the temperature effect of the cosmic ray neutron component in the presence of the primary component variation having a large amplitude. The variations of primary origin are excluded by subtracting the data of one station from the data of another; both stations have close rigidities of the geomagnetic cutoff and are located in different hemispheres. The data of the Hobbart and Chicago stations are used. Investigation of the differences in the mean-monthly values of the intensities at these stations for 1957–1962 made it possible to isolate the seasonal wave which is due to the seasonal changes in the atmospheric temperature. The five-year mean amplitude of this effect in the neutron component is 2.1 times as great as the theoretically calculated value. The possible causes of the difference between the experimental and theoretical results are discussed. Author

N68-15062# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

ABOUT THE POSSIBILITY OF THE DETERMINATION OF THE TEMPERATURE CONTRIBUTION TO THE DIURNAL VARIATION OF THE COSMIC RAY HARD COMPONENT

A. A. Luzov and V. P. Mamrukova *In its* Cosmic Rays, No. 8 1967 p 113–116 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

On the basis of the propositions of the random process theory, the amplitude characteristics of the diurnal temperature wave have been determined. The presence of the regular and irregular parts of this wave have been established, and the contribution of these parts to the diurnal variation of the cosmic ray component has been evaluated. Author

N68-15063# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE PLANETARY DISTRIBUTION OF COSMIC RAY INTENSITY AND THE TEMPERATURE EFFECT

N. S. Kaminer, S. F. Ilgatch, and T. S. Khadakhanova *In its* Cosmic Rays, No. 8 1967 p 117–127 refs (See N68-15050 06-29)

The influence of the planetary distribution of temperature upon the latitudinal changes of the measured cosmic ray intensity is studied. The temperature effect for the hard component of the cosmic rays was determined from the data of 57 aerological stations located in the American, European, and Asian regions, and regularly distributed over the whole latitude range. The year-to-year changes of the mean-yearly and seasonal curves of the latitudinal change of the temperature effect on the earth's surface and at the isobaric levels of 700, 500, and 300 mb were found. The latitudinal changes of the neutron component temperature effect were determined for the summer and winter seasons. The obtained results are used to take account of the temperature effect in the curves of the latitudinal changes of the cosmic rays. Author

N68-15064# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE ASYMPTOTIC DIRECTIONS OF THE COSMIC RAYS FOR THE SOVIET NETWORK OF STATIONS

L. I. Dorman and V. S. Smirnov *In its* Cosmic Rays, No. 8 1967 p 128–151 refs (See N68-15050 06-29)

Results are presented of calculations of about 5000 cosmic ray trajectories in the geomagnetic field represented by six spherical functions in order to determine the asymptotic directions for 13 Soviet stations of continuous recording of cosmic rays. The coefficients g_n^m and h_n^m were used in the calculations. These coefficients have been obtained on the basis of the spherical analysis of the geomagnetic maps compiled for the 1960 epoch. The trajectories were integrated for the particles with the rigidity in the range from 0.85 BV to 350 BV arriving at the vertical at angles of 16° and 32° (and for some complex stations at an angle of 48° as well) from the north, south, east, and west directions. The calculation results bearing on the geographic latitude and longitude of the asymptotic directions have been listed in the tables. Author

N68-15065# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE NEUTRON COMPONENT LATITUDE EFFECT ACCORDING TO THE MEASUREMENTS FROM THE SCHOONER "ZARYA" IN 1960

L. I. Dorman, N. S. Kaminer, A. A. Manshilina, and Yu. I. Okulov *In its* Cosmic Rays, No. 8 1967 p 151–152 refs. Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

On the basis of the obtained data, it has been shown that the divergence between the branches of the latitude dependence curve for the Northern and Southern Hemispheres as the function of Quenby and Wenk's cutoff rigidities is substantially greater than the experimental errors, which is in agreement with the results of other authors. The dependence of the integral multiplicity upon the energy has been determined for 15 to 4.7 BeV energy range on the assumption that the intensity is linearly dependent on the cutoff rigidity. Author

N68-15066# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE MEASUREMENTS OF THE LATITUDE EFFECT AND THE COUPLING COEFFICIENT OF THE INCLINED COSMIC RAY COMPONENT

L. I. Dorman and E. A. Mazaryuk *In its* Cosmic Rays, No. 8 1967 p 153–157 refs (See N68-15050 06-29)

Regarding the creation of inclined supertelescopes, one should define coupling coefficients for inclined components of cosmic radiation. Registration of intensity was made with the help of the device which is an element of the azimuth supertelescope. The measurement results and calculations of the coupling coefficients for the vertical and inclined components of the two opposite azimuths (northwest and southeast) are given. Author

N68-15067# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE PENUMBRA AND THE CHANGES IN THE EFFECTIVE RIGIDITY OF THE GEOMAGNETIC COSMIC RAY CUT OFF WITH CHANGE OF THE PRIMARY SPECTRUM AT THE GEOMAGNETIC FIELD CONSTANCY

L. I. Dorman and R. T. Gusshina *In its* Cosmic Rays, No. 8 1967 p 158–167 refs (See N68-15050 06-29)

The calculation is presented for the effective rigidity of the geomagnetic cutoff in the presence of the penumbra and the change in this rigidity according to the detection at geomagnetic latitudes of 30°, 40° and 50° by means of various components: from the low orbiting satellites and in the stratosphere; the neutron component at an altitude of 10 km at the mountain level and at the sea level; the hard component at an altitude of 10 km, at the sea level; and underground at the depths of 3 and 7 m.w.e. Also found are the expected changes in the effective cutoff rigidity for the

constant geomagnetic field, by means of the various instruments for the primary variations of the type of increases due to chromospheric eruptions and the modulation effects of various types. Author

N68-15068# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE PRESENT STATE OF THE PROBLEM OF SOLAR COSMIC RAY GENERATION
L. I. Dorman and L. V. Raitchenko *In its* Cosmic Rays, No. 8 p 168–193 refs (See N68-15050 06-29)

An attempt is made to associate the available observation results bearing on the solar flares and accompanying events with the data of the detection of the solar cosmic rays as one of the solar activity displays. The results of numerous investigations of the regularities in the appearance and development of the solar chromospheric eruptions responsible for the solar cosmic ray generation are presented, and theories bearing on the processes taking place in the eruptions are discussed in detail. The solar cosmic ray energy spectra are studied, and possible interpretations of various spectral presentations are analyzed. The data on the nuclear composition of the solar cosmic rays are considered, and various hypotheses of the origin of the observed composition are discussed. The importance is noted of the further study of the spectra and chemical composition of the solar cosmic rays and of the investigation of the possibility of the predominant acceleration of the heavy nuclei for elucidating the mechanisms of the solar cosmic ray generation and the regions of the effective action of these mechanisms. Author

N68-15069# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
SOME PROBLEMS OF THE SOLAR COSMIC RAY STUDY
L. I. Dorman and L. I. Miroshnitchenko *In its* Cosmic Rays, No. 8 1967 p 194–197 refs (See N68-15050 06-29)

The dependence of the diffusion coefficient of the solar cosmic rays upon their energy and distance to the sun has been studied. The magnetic field strength in the inhomogeneities, their dimensions, and distances between them have been evaluated. The spectrum of the solar particle generation in the energy range 1–1000 MeV has been given in relation to the influence of the duration of the solar cosmic ray emission from the acceleration region upon the spatial–time distribution of these cosmic rays in interplanetary space. The multiplicity factors of the generation of the neutron and hard components in the atmosphere have been calculated. Author

N68-15070# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE TRANSISTORIZED AZIMUTH SUPERTELESCOPE
E. A. Mazaryuk *In its* Cosmic Rays, No. 8 1967 p 198–202 refs (See N68-15050 06-29)

The geometry and electronic block of the model of the azimuth supertelescope are described. The installation is intended for measuring the general ionizing component of the cosmic rays from four azimuths at an angle of 33° to the vertical and from two vertical directions with different solid angles. The statistical accuracy for every oblique component must be 0.1 per cent in two hours (for two sections) and 0.1 per cent in two hours for either vertical. Author

N68-15073# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE USE OF COSMIC RAYS FOR THE SOLUTION OF SOME GEOLOGICAL PROBLEMS
Ya. L. Blokh, V. M. Bondarenko, and A. G. Tarkhov *In its* Cosmic Rays, No. 8 1967 p 209–213 refs Presented at the All-Union Conf. on Cosmic Ray Phys., Apatity, USSR, Sep. 1964 (See N68-15050 06-29)

The possibility and practical use of the cosmic rays for the solution of a number of the geological and engineering problems are considered. The theoretical calculations are compared with the results of the field works. A very good coincidence has been obtained. It has been shown that the method may be widely used in the search for mineral deposits, and for determination of the mean density of the rocks over a mine. Author

N68-15074# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
ON THE THEORY OF THE INTERACTION OF ELECTRIC AND MAGNETIC CHARGES
L. I. Dorman and Yu. I. Okulov *In its* Cosmic Rays, No. 8 1967 p 214–221 refs (See N68-15050 06-29)

The Lagrangian of the interaction of an electric charge with the field induced by a scalar magnetic charge has been obtained. It has been shown that if the magnetic charge has the spin 1/2 then the particle should have an electric dipole pulse as well. The evaluation of the electric dipole pulse of neutrino has been obtained on the assumption that the neutrino has the scalar magnetic charge. Author

N68-15075# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
ABOUT THE ELECTRIC DIPOLE MOMENT OF NEUTRINO
L. I. Dorman and Yu. I. Okulov *In its* Cosmic Rays, No. 8 1967 p 222–223 refs (See N68-15050 06-29)

The minimum interaction of a magnetic charge with the electromagnetic field makes it possible to draw the conclusion that a magnetic particle with the spin 1/2 must have an electric dipole moment. It has been proved that the pseudophotonic interaction which might belong to ν_μ corresponds to the interaction of the electric dipole moment with the electromagnetic field of the scalar magnetic charge g. Author

N68-15076# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE NEUTRINO OCEAN IN THE UNIVERSE
G. E. Kocharov *In its* Cosmic Rays, No. 8 1967 p 224–232 refs (See N68-15050 06-29)

The existing data on the sea of neutrinos in the universe are generalized, and the experimental possibilities of the determination of the Fermi energy for the neutrino sea are considered. The problems discussed bear on the energy density and neutrino concentration in the universe under various assumptions on the nature of the neutrino sources: the ones that appeared simultaneously with the origin of the universe, the neutrino generation as a result of various neutrino processes in the stars, and production during the interactions of the cosmic rays with the interstellar medium. The neutrino gravitation action on the expanding universe is considered. The experimental data about the sea of neutrinos, giving the upper estimates for the neutrino density and the neutrino energy density in the universe, are discussed in detail. Author

N68-15077# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.
THE METHODICAL PROBLEMS OF THE STUDY OF THE COSMIC RAY VARIATIONS
L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 233–241 refs (See N68-15050 06-29)

A simultaneous amplitude–phase modulation of the periodic cosmic ray variation is studied, and the satellite properties of any order are found. The general expressions for the satellites in the presence of true waves have been obtained. A solution is presented for the inverse problem of the determination of the modulation parameters and true waves from the experimentally measured satellites. The problem is also considered bearing on the contribution of the features of the solar system geometry to the observed cosmic ray variations (the effect of the lack of coincidence of the earth and sun rotation axes with the perpendicular to the ecliptic plane; and asymmetry of the distribution of the magnetic inhomogeneity flux from the sun in the meridional plane). Author

N68-15078# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE THEORY OF THE METEOROLOGICAL EFFECTS IN THE COSMIC RAY MESON COMPONENT TAKING ACCOUNT OF THE DATA ABOUT AN ELEMENTARY EVENT

V. V. Viskov, L. I. Dorman, and T. M. Krupitskaya *In its* Cosmic Rays, No. 8 1967 p 242–246 refs (See N68-15050 06-29)

A method is proposed bearing on the calculation of the meteorological corrections in the meson component proceding from the expressions for the integral multiplicity obtained on the basis of the three-dimensional model of an elementary event. The problem of the choice of a method bearing on the problem solution using a computer is given consideration. Author

N68-15079# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

DETERMINATION OF THE COSMIC RAY BAROMETRIC EFFECT USING THE PARTIAL BAROMETRIC COEFFICIENT

L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 247–249 ref (See N68-15050 06-29)

Methods are developed for the determination of the cosmic ray barometric effect taking account of the interference of the cosmic ray variations of various types using the partial barometric coefficient. The expansion of the barometric effect in the power series $h-h_0$ has been obtained. This expansion is determined for the primary spectrum of the variation. Author

N68-15080# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE AMPLITUDE-PHASE MODULATION OF PERIODIC COSMIC RAY VARIATIONS BY TWO FREQUENCIES SIMULTANEOUSLY

L. I. Dorman and E. A. Mazaryuk *In its* Cosmic Rays, No. 8 1967 p 250–274 refs (See N68-15050 06-29)

The problem of the amplitude-phase modulation by two frequencies simultaneously is solved. The expressions have been obtained for the satellites of any order appearing as a result of this process. The coefficients which are the members of these expressions have been found using the electronic computer, M20. The tables are presented showing the values of these coefficients for various modulation depths. Author

N68-15081# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE COSMIC RAY VARIATIONS AS THE AGGREGATE OF CAUSAL EVENTS AND RANDOM PROCESSES

L. I. Dorman and A. A. Luzov *In its* Cosmic Rays, No. 8 1967 p 275–284 refs (See N68-15050 06-29)

Consideration of cosmic ray variations, on the basis of the theory of random processes, permitted the following conclusions to be drawn: (1) The observed cosmic ray intensity variations may be considered as a random stochastic process. (2) A direct determination of the simplest numerical characteristics of the cosmic ray variations as a random process, based on a great variety of realizations, does not seem to be possible because of the absence of density in the conditions of a process realization. (3) Another method of adopting the random process theory to the cosmic ray variations is to apply the theory to a single realization at any station within the worldwide network. This makes it possible to obtain various numerical and statistical characteristics of the cosmic ray variations at each station. Author

N68-15082# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE OBTAINMENT OF INFORMATION ON THE PARAMETERS OF COSMIC RAY VARIATIONS USING METHODS OF THE RANDOM PROCESS THEORY

L. I. Dorman and A. A. Luzov *In its* Cosmic Rays, No. 8 1967 p 285–304 refs (See N68-15050 06-29)

It has been shown that since the cosmic ray intensity is of statistical nature and undergoes various influences of the geophysical and helio-physical events, the determination of the variation parameters is possible only by the treatment of the material from each cosmic ray station with subsequent use of the so-obtained results for qualitative investigations. Since the cosmic ray intensity is a random process and therefore transient, the noise may be avoided and the regular connections may be isolated by means of linear filters which operate as the flattening ones. The most appropriate filters may be the filters with a weighing function of the Gauss curve type. They are easily plottable, introduce weak statistical connections into the experimental data, and permit a simple realization of the reversed filters to obtain the differential data. The differential data which include the short-periodic cosmic ray variations are also a random process which is closer to a stationary one. This makes it possible to analyze them correlationally and to determine the qualitative characteristics of the variations by means of this analysis. Author

N68-15083# Academy of Sciences (USSR), Moscow. Soviet Geophysical Committee.

THE COSMIC RAY MODULATION IN INTERPLANETARY SPACE

L. I. Dorman *In its* Cosmic Rays, No. 8 1967 p 305–320 refs (See N68-15050 06-29)

Consideration is given to the approximation of the anisotropic diffusion in the dynamic model associated with the displays of the solar wind of the magnetic field inhomogeneity flux from the sun, with the propagation of shock waves and with the presence of the large scale spiral-like interplanetary magnetic field. The lag of events in the interplanetary space with respect to the events on the sun is taken into account. The behavior of the solar cosmic rays in the interplanetary space and their modulation are also studied. The results bearing on the state of the interplanetary space obtained in the course of investigation of the intensity variations of the galactic and solar cosmic rays are compared with the data of the direct measurements from the satellites and space probes. Author

N68-15171# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.

OBSERVED ABSENCE OF ENERGETIC ELECTRONS AND PROTONS NEAR VENUS Progress Report, Nov. 1967

J. A. Van Allen, S. M. Krimigis, L. A. Frank, and T. P. Armstrong Nov. 1967 22 p refs

(Contract Nonr-1509(06))

(Rept.-67-66; AD-662227)

The report discusses the following points: (a) The environment of Venus is almost, if not completely, devoid of energetic particles associated with the planet, as is the environment of Mars and that of the moon. (b) On the basis of physical similitude with observational and theoretical knowledge of the earths magnetosphere, we conclude that the intrinsic magnetic dipole moment of Venus is certainly less than 0.01 and probably less than 0.001 of that of the earth. Corresponding upper limits on the equatorial surface magnetic field of Venus are about 350 and 35 x 10 to the -5th power gauss, respectively. (c) The magneto-fluid dynamical interaction of the solar wind with the conducting ionosphere and/or the body of Venus is too weak to generate an observable intensity of electrons having energies exceeding 45 keV. TAB

N68-15174*# Volt Technical Corp., Washington, D. C.
ESTIMATES OF THE UPPER LIMIT OF ION TEMPERATURE IN THE 7000–30,000 KM ALTITUDE RANGE ACCORDING TO MEASUREMENTS ABOARD AES "ELEKTRON-2"
V. V. Bezrukikh, T. K. Breus, and K. I. Gringauz 29 Dec. 1967 4 p refs Transl. into ENGLISH from Kosmich. Issled. (USSR), v. 5, no. 5, 1967 p 798–799
(Contract NAS5-12487)
(NASA-CR-92535; ST-PF-IF-10664) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Estimates of the upper limit of ion temperature in the 7000–30000 km. altitude range are made with the aid of an earlier described method, using the data of collector current variations of the charged particle trap, having a zero potential in the outer grid because of spacecraft spinning. Author

N68-15175# Aerospace Corp., El Segundo, Calif. Space Physics Lab.
ATS-1 OMNIDIRECTIONAL SPECTROMETER Quarterly Report, 15 May–15 Aug. 1967
G. A. Paulikas, J. B. Blake, S. C. Freden, and S. S. Imamoto Oct. 1967 31 p refs
(Contract F04695-67-C-0158)
(TR-0158(3260-20)-4; SAMSO-TR-67-100; AD-663234)

Continuing analysis of electron data from the ATS-1 omnidirectional spectrometer shows (a) an electron flux vs time structure that exhibits periodicity probably associated with the interplanetary field sector structure, and (b) that magnetometer data fail to organize electron flux data; i.e., the electron flux variations are governed by temporal effects. Proton fluxes, some associated with flares, have been detected a surprisingly large fraction of the time. Further details of the proton events in January and February 1967 are presented. Author (TAB)

N68-15232*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
A CINEMATOGRAPHIC DISPLAY OF OBSERVATIONS OF LOW-ENERGY PROTON AND ELECTRON SPECTRA IN THE TERRESTRIAL MAGNETOSPHERE Progress Report, Nov. 1967
L. A. Frank and W. L. Shope Nov. 1967 27 p refs
(Contract NAS5-2054; Grant NsG-233-62; Contract Nonr-1509 (06))
(NASA-CR-91871; Rept.-67-67; AD-662228) CFSTI: HC $3.00/MF $0.65 CSCL 04A

A massive series of observations of the differential energy spectra of proton and electron intensities over the energy range of approximately 300 eV to 50 keV within the earths magnetosphere and its environs has been obtained with an array of electrostatic analyzers borne on the earth-satellite OGO 3. In order to supplement the presently existing publications derived from these observations and to provide further insight into the distributions of low-energy charged particles within the earths radiation zones over geocentric radial distances of approximately 2 to 20 RE (RE, earth radii) we have utilized a SC 4020 microfilm plotter to construct a cinematographic display of the differential energy spectra of proton and electron intensities which spans a complete circuit of the spacecraft around the earth, or about 50 hours of substantially continuous observations beginning at 1330 U.T. on July 14, 1966. This cinematographic display comprises approximately 18,000 individual frames and summarizes some 550,000 intensity measurements. A description of the methods and graphic results is furnished as an aid in interpretation of this visual presentation of the observations. Author (TAB)

N68-15296*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
THE MAGNETOSPHERIC RADIATION BELT AND TAIL PLASMA SHEET
J. H. Piddington Nov. 1967 40 p refs
(Grant NsG-233-62)
(NASA-CR-92565; Rept.-67-69) CFSTI: HC $3.00/MF $0.65 CSCL 04A

Theories of the origin of the storm-time radiation belt (the ring current) and associated bays and auroras have invoked hydromagnetic flow *from* the magnetotail on the one hand and flow *into* the tail on the other. It is shown that both flow patterns occur, the inward flow being the source of energy and driving the major magnetospheric convection pattern. The following phenomena are explained: (1) The tail plasma sheet is formed by the outward Hall drift of plasma from the storm-time radiation zone. (2) On a smaller scale, bubbles of plasma from the radiation zone are released into the tail, accounting for the observed islands of tail electrons, spikes of electrons seen just above the ionosphere, and energetic protons (≅300 keV) which have been seen in the tail. (3) The storm or bay ionospheric current system (DP1) develops from the quiet-time system (DP2) as a result of the magnetospheric space charge field and changed ionospheric conductivity caused by auroral precipitation. (4) Quiet auroral arcs and auroral substorms are due to electron precipitation from regions of low magnetic field strength, where the first invariant (of trapped particles) is lost. The intermittent ejection of plasma from the radiation belt suggests that the model be termed the burping radiation belt. Author

N68-15316# Deutsche Versuchsanstalt fur Luft- und Raumfahrt, Munich (West Germany). Inst. fuer Physik der Atmosphaere.
EXPERIMENTAL DETERMINATION OF THE SOLAR CHROMOSPHERIC–ULTRAVIOLET RADIATION AS PART OF THE SOLAR ECLIPSE PROGRAM OF ESRO [EIN EXPERIMENT ZUR BESTIMMUNG DER CHROMOSPHAERISCHEN UV-STRAHLUNG DER SONNE IM RAHMEN DES SONNENFINSTERNIS-PROGRAMMS DER ESRO]
F. Dolainsky and A. Rossbach Bad Godesberg, W. Ger. Bundesmin. fuer Wiss. Forsch. Jun. 1967 19 p In GERMAN; ENGLISH summary
(BMwF-FB-W-67-12)

Two flight models of an UV-monochromator have been flown during the solar eclipse program of ESRO in Euböa/Greece. The lay-out of the equipment and its electrical function are described. The radiation of the chromosphere during the maximum of the solar eclipse within the wave length range of 1500 and 1500+1800 Å has been recorded from 144 until 159 sec and 263 until 278 sec after launch. About two hours later, the same experiment was flown in a second rocket to get the necessary reference values. By a deviation in the trajectory of the rocket, the solar disk was out of the aspect angle of the monochromator. Thus, it was not possible to receive detailed information about the limb darkening. Author

N68-15669# Danish Space Research Institute, Lyngby.
COSMIC RADIATION AND ITS ORIGIN: CONTEMPORARY PROBLEMS
B. Peters Paris ESRO Oct. 1967 23 p refs Presented at the Joint ESLAB/ESRIN Symp. on Satellite and Rocket Meas. of Corpuscular Radiation from Outer Space, Noordwijk, Holland, 10–14 Jul. 1967
(ESRO-SN-76)

The nature and origin of cosmic radiation are known only in barest outline. Major areas of uncertainties could be reduced by a more detailed study of various components. Some of these studies, though of outstanding importance, lie outside the existing technological capability (e.g. neutrinos); others seem feasible even though they require advanced space technology and must be supported by greatly refined investigations of nuclear reactions in low and high energy accelerators. Of particular importance are at present more precise measurements of the energy spectrum of galactic electrons, of the flux of high energy γ-rays, of positrons, and of radioactive components, such as beryllium isotopes and nuclei of atomic weight greater than that of lead. Author (ESRO)

N68-15875*# Volt Technical Corp., Washington, D. C.
EXTRA-ATMOSPHERIC MEASUREMENTS OF THE ULTRAVIOLET AND X-RAY BACKGROUNDS AND THEIR ROLE IN THE STUDY OF INTERGALACTIC GAS
V. G. Kurt and R. A. Syunayev 29 Jan. 1968 31 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), no. 4, 1967 p 573–592
(Contract NAS5-12487)
(NASA-CR-92549; ST-IGA-CMG-10666) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Results are given of background measurements in the ultraviolet (UV) wavelength range. It is shown that combined UV and X-ray measurements make it possible to determine the density and "thermal history" of the intergalactic medium and, consequently, to estimate the density of matter in the Universe. It is concluded that the background in the UV spectral region from extra galactic nebulae, stars and interplanetary medium does not exceed 10^{-26} to 10^{-27} w/m^2 - ster - htz. Author

N68-15940*# Volt Technical Corp., Washington, D. C.
OBSERVATIONS OF SCATTERED L_α EMISSION IN THE VICINITY OF THE EARTH AND IN THE INTERPLANETARY MEDIUM [NABLYUDENIYA RASSEYANNOGO L IZLUCHENIYA V OKRESNOSTYAKH ZEMLI I V MEZHPLANETNOY SREDE]
V. G. Kurt 30 Jan. 1968 12 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 5, no. 6, 1967 p 911–920
(Contract NAS5-12487)
(NASA-CR-92524; ST-OA-SP-10669) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Measurements of ultraviolet emission in two bands: λ 1050–1340 A and 1225–1340 A have been conducted on AIS "VENERA-2" and "VENERA-3", respectively launched on 12 and 16 November 1965. By the emission intensity in the first band, including the line $L_\alpha(\lambda$ 1216 A) the density was computed of atomic hydrogen near the Earth and to 20 R_E (Venera-2) and to 7 R_E (Venera-3). At the distance of 5 R_E the density was 25 cm^{-3}. At great distances from the Earth the concentration of neutral hydrogen decreases proportionally to $R^{-2.1}$ and $R^{-2.3}$. The measured density was found to be in good agreement with the data of preceding measurements on AIS "ZOND-1". In the interplanetary medium far from Earth, the intensity of L_α-emission is $7 \cdot 10^{-8}$ erg/cm^2-sec-ster, which corresponds to the density of neutral component of the interplanetary medium $\approx 3 \cdot 10^{-3}$cm^{-3} for the "hot" interplanetary gas model. A systematic slow intensity increase by about 20 to 30 percent was observed as the AIS approached the Sun. During chromospheric flares of force 2 no intensity increase of the scattered L_α-emission was observed. Nor was any correlation observed with the areas of calcium flocculi and spots on the Sun's disk. Author

N68-16008*# National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.
MCFLARE, A MONTE CARLO CODE TO SIMULATE SOLAR FLARE EVENTS AND ESTIMATE PROBABLE DOSES ENCOUNTERED ON INTERPLANETARY MISSIONS
Gerald P. Lahti, Irving M. Karp, and Burt M. Rosenbaum Washington Feb. 1968 55 p refs
(NASA-TN-D-4311) CFSTI: HC $3.00/MF $0.65 CSCL 03B

A computer program MCFLARE that uses Monte Carlo methods to simulate solar flare occurrences during an interplanetary space voyage is described. The total biological dose inside a shielded crew compartment due to the flares encountered during the voyage is determined. The computer program evaluates the doses obtained on a large number of trips having identical trajectories. From these results, a dose D_p having a probability p of not being exceeded during the voyage can be determined as a function of p for any shield material configuration. The user of the code selects any number of solar flares considered to be representative of the ones that will occur during future solar active periods. The flares are assumed to occur randomly during these periods. The dose at a distance of 1 astronomical unit (1.496×10^8 km) from the Sun from each of these flares behind any shield configuration investigated is input to the MCFLARE code. The code accounts for the dependence of the dose received from a flare on the distance from the Sun according to a $(1/r)^\alpha$ variation, where r is the distance from the Sun and the exponent α can be assigned any integral value including zero. To illustrate the use of the code, a trip to Mars and return is calculated, and estimated doses behind several thicknesses of aluminum shield and water shield are presented. A FORTRAN IV listing, data input instructions, and sample output are given. Author

N68-16072*# Southwest Center for Advanced Studies, Dallas, Tex.
ENVIRONMENT FOR MANNED PLANETARY MISSIONS
Francis S. Johnson [1968] 6 p refs
(Grant NsG-269)
(NASA-CR-92702) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The radiation hazard in space is discussed in terms of Van Allen radiation and solar flare proton radiation; radiation presents a significant hazard but it is apparently tolerable if shielding is as great as 10 g cm^{-2}. The meteorite hazard is comparable; penetration is unlikely if the wall thickness corresponds to mass densities as high as those required for radiation shielding. Neither Mars nor Venus has a magnetosphere like that of earth, and hence no radiation belt; however, both have induced magnetospheres. The atmosphere of Mars is so thin as to complicate the landing problem there. The atmosphere of Venus is very thick; recent observations in Mariner 5 and Venus 4 permit a more detailed description of the atmosphere of Venus than that of Mars. Author

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N68-15027 Joint Publications Research Service, Washington, D. C.
ASTRONOMY
In its Soviet-Bloc Res. in Geophys., Astronomy, and Space, No. 172 16 Jan. 1968 p 1–5 refs Transl. into ENGLISH from Izv. (Moscow), 15 Dec. 1967 p 4 (See N68-15026 06-13)

Abstracted data on recent astronomical observations are presented. Topics covered include the following: solar flare spectra; right ascensions of planets; lunar volcanic activity and lunar crater structures; cosmic rays in meteorites; intergalactic medium observations; and radiophysical studies of Venus. The publication of a new star catalog is mentioned, and a new observatory in Estonia is briefly described. N.E.N.

N68-15085# Osservatorio Astrofisico, Asiago (Italy).
INVESTIGATIONS ON FLARE STARS AND NEBULAE Final Report
L. Rosino 30 Apr. 1966 17 p
(Grant AF-EOAR-64-56)
(AFCRL-66-418; AD-662900)

The first part of the report deals with the searching of flare stars in the Pleiades and Praesepe clusters. 13 flares have been found on the Pleiades and 2 on the Praesepe. Position and characteristics of the flare stars are given. The second part deals with the study of the Orion Nebula with monochromatic liquid filters. The results are contained in the Supplement to the Monochromatic Atlas of the Orion Nebula of Wurm-Rosino and are here summarized. In the third part are given the spectral types of stars in or near the Orion Nebula derived by photographs taken with the objective prism applied to the Schmidt telescope of 40 cm. Author (TAB)

N68-15087# Douglas Aircraft Co., Inc., Huntington Beach, Calif. Missile and Space Systems Div.
ALTERNATE MANNED PLANETARY FLYBY MISSIONS
R. G. Riedesel and J. L. Woodworth 14 Jun. 1967 23 p ref Presented at the Natl. Symp. Am. Astronautical Soc., Huntsville, Ala., 11–14 Jun. 1967
(Douglas Paper-4460)

Identified and described are three manned planetary flyby missions that may be considered as alternates to the classical, direct, low-energy flyby missions to Mars and Venus previously defined and currently under study for the 1975–1982 time period. Mission and operational characteristics that led to investigation of these alternate missions are reduced mission duration, elimination of passage into the asteroid belt, lower planet passage speeds, and the potential gain in return of significant scientific data. The specific alternate missions analyzed are the 1976 Perihelion Maneuver Mars Flyby, the 1978 Free Return Venus/Mars Flyby, and the 1978 Powered Venus-Mars Flyby. Mission characteristics are defined in terms of Earth-departure energy requirements, perihelion maneuver and powered turn velocity increment, target planet approach speed, target planet passage distance, and Earth-return velocity. Also analyzed are such characteristics as total mission time, mission trajectory profile, and available Earth-departure launch windows and launch ignition windows. The data for these alternate missions are compared to the classical mission data. Assessment is made of differences in energy requirements, mission durations, mission trajectory profile, and system gross weight. Author

N68-15117*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SOLAR ACTIVITY: A BIBLIOGRAPHY
Herbert P. Eckstein Redstone Arsenal, Ala. Redstone Sci. Inform. Center 28 Sep. 1967 176 p Prepared jointly with Army Missile Command
(NASA-TM-X-60851; RSIC-708) CFSTI: HC $3.00/MF $0.65 CSCL 03B

This bibliography contains 512 citations to articles on solar activity as evidenced by sunspots, flares, and cosmic and terrestrial effects. In addition, there are listed books dealing with solar activity, and observatory publications and other periodicals reporting routinely observational data and forecasts of periodic events. Author

N68-15124# European Southern Observatory, Hamburg (West Germany).
ESO BULLETIN NUMBER 1
Nov. 1966 50 p refs In FRENCH; GERMAN; and ENGLISH
CFSTI: HC $3.00/MF $0.65

An astronomical comparison between South Africa and Chile is presented, meteorological observations on La Silla in Chile are reported, and activities and capabilities of the European Southern Observatory (ESO) at Zeekoegat in South Africa are reviewed. Requirements and design are described for a 1 m photometric telescope which is intended for photoelectric measurements in the Cassegrain focus by a single observer; and photometric equipment of the ESO 1 m telescope is detailed. Discussions and activities at a three-day ESO colloquium on astronomical photometry held in 1966 are summarized. M.W.R.

N68-15136*# Volt Technical Corp., Washington, D. C.
APPLICATION OF THE DELAUNAY METHOD TO THE ARTIFICIAL SATELLITES OF THE MOON
E. N. Lemekhova 29 Dec. 1967 23 p refs Transl. into ENGLISH from Byul. Inst. Teor. Astron. (USSR), v. 8, no. 7 (100), 1962 p 512–530
(Contract NAS1-2487)
(NASA-CR-92536; ST-CM-10663) CFSTI: HC $3.00/MF $0.65 CSCL 03C

This paper deals with the motion of three fictitious satellites of the moon in the lunar equatorial plane, their orbits with eccentricities of 0.18 being at a distance of 2, 4 and 8 lunar radii from the moon. The motion takes place in the gravitational field of the moon under the influence of perturbations caused by the earth, and of the sun. The effect of the figure of the moon is not taken into account. The Delaunay method is used for the solution of these problems. Author

N68-15138*# Aztec School of Languages, Inc., Acton, Mass. Research Translation Div.
COMETS IN THE SOLAR WIND [KOMETEN IN SONNENWIND]
B. Brosowski and H. U. Schmidt Washington NASA Jan. 1968 9 p refs Transl. into ENGLISH of Max-Planck Inst. for Phys. and Astrophys. MPI-PAE/Astro-1/67 (Munich), 1967 p 1–11
(Contract NASw-1692)
(NASA-TT-F-11416) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Interaction of cometary and solar plasma components is sufficiently great to permit assumption of a common flow velocity and description of the process as a continuum. The density distribution of ions is regulated by their entrainment in the solar wind rather than by the spatial distribution of ionization probability. It is mainly the position of the shock front and the flow conditions in the low density regions remote from the head of the comet which are influenced by the variable parameters, while the position of the interface and the density and velocity of the cometary gas in the vicinity of the head of the comet are only slightly affected. The influence of the charge exchange and ionization by electron impact are considered and the results discussed. Author

N68-15185*# Scientific Translation Service, La Canada, Calif.
MEASUREMENT OF THE DIAMETER OF MERCURY BY THE HERTZSPRUNG METHOD ON NOVEMBER 7, 1960 [MESURE DU DIAMETRE DE MERCURE PAR LA METHODE DE HERTZSPRUNG LE 7 NOVEMBER 1960]
H. Camichel, M. Hugon, and J. Roesch Aug. 1967 16 p refs Transl. into ENGLISH from Icarus, v. 3, 1964 p 410–422 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92595) CFSTI: HC $3.00/MF $0.65 CSCL 03A

Observations of the transit of Mercury on November 7, 1960, by Hertzsprung's photometric method and their reduction are described. A general interpretation is given of the discrepancy between double-image micrometer and photometric measurements of small discs. Laboratory experiments have been conducted, affording a complete agreement with this explanation. The effect of the limited diameter of the hole used is also discussed and a correction computed. Finally, the proposed values are 6"84±0"03 for the angular diameter at unit distance, and 5.09±0.07 for the density. Author

N68-15187*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
ABSOLUTE OPTICAL FLUX OBSERVATIONS OF THE 18 OCTOBER 1967 TOTAL ECLIPSE OF THE MOON
J. S. Neff Jan. 1968 27 p refs
(Grant NsG-233-62)
(NASA-CR-92527; Rept.-68-1) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Absolute optical flux observations at $\lambda = 0.33\mu$, 0.37μ, 0.47μ and 0.55μ are presented for the descending branch and total phase of the 18 October 1967 lunar eclipse. A brief description of the photometer and photometric system is given with a discussion of the observational and reduction procedures for the lunar photometry. The observed photon flux at the top of the earth's atmosphere is converted into the photon flux incident on the moon and the ratio of this flux to that of the uneclipsed sun (attenuation factor) is calculated. The eclipse was a normal eclipse, the attenuation factor at $\lambda = 0.55\mu$ was 10^{-5} and the moon was red, i.e. B–V≃6. The attenuation versus time curves were asymmetrical for the longer wavelengths. The integrated energy flux for the 0.33–0.55 μ spectral region was compared with the charged particle energy flux on the lunar surface, for the purpose of examining the possibility of direct excitation of lunar luminescence. The charged particle fluxes were determined from observations by Explorer 35, orbiting the moon, and OGO III and Explorer 34 inside the magnetosphere. Author

N68-15189*# Massachusetts Inst. of Tech., Cambridge. Lab. for Nuclear Science.
SHOCK AND MAGNETOPAUSE BOUNDARY OBSERVATIONS WITH IMP-2
Joseph H. Binsack 28 Jun. 1967 37 p refs Presented at the Summer Inst. Phys. of the Magnetosphere, Boston Coll., Chestnut Hill, Mass., 19–28 Jun. 1967
(Contracts NAS5-2952; AT(30-1)-2098; Grant NSG-386)
(NASA-CR-91901) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The magnetopause and bow shock boundaries data obtained from the flight of the IMP-2 satellite are discussed. The boundary crossings during the first twelve orbits of the IMP-2 are catalogued into one of six types, determined by the character of the signals observed before and after the crossing. Plasma experiment data show that the boundaries of the magnetosheath are extremely pliable and responsive to solar and geomagnetic activity. Even during relatively quiet periods, the boundaries appear to remain in motion although on a smaller scale. Rapid varying fluxes in energy and direction are observed to be characteristic of the shock boundary layer. The operations of the plasma detector are reviewed. B.S.D.

N68-15190*# State Univ., of Iowa, Iowa City. Dept. of Physics and Astronomy.
ELECTRODYNAMIC EFFECTS OF JUPITER'S SATELLITE IO
J. H. Piddington and J. F. Drake Nov. 1967 19 p refs
(Grant NsG-233-62)
(NASA-CR-92562; Rept.-67-64) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Consideration is given to the form taken by the interaction between Io and the magnetosphere. An assessment is made of the factors influencing Io's hydromagnetic disturbance, and a figure is included to depict the passage of the satellite Io through the magnetic field of Jupiter. It is shown that the field lines frozen into Io move with the satellite to create an external wave; Io's force tube (IFT) rotates with Io relative to the planet as an interchange motion. Wave propagation to the ionosphere is discussed. Two plots of Jupiter in Longitude System III are presented. These depict the high latitude ionosphere showing the rotational and magnetic axes and the path of the foot of the IFT; and the apparent emission regions of decametric radio bursts, and the manner in which most emission may originate from one region. In connection with the remarkable optical properties of Io, it is noted that new magnetic field lines enter Io as old ones leave, and the plasma on the new lines is absorbed by Io. M.G.J.

N68-15193*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 4: THE CALCULUS OF VARIATIONS AND MODERN APPLICATIONS
M. Mangad and M. D. Schwartz Washington NASA Jan. 1968 117 p refs
(Contract NAS8-11495)
(NASA-CR-1003; SID-65-1200-4) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The discussions presented progress from the fundamental lemma to the Euler–Lagrange equations, to the transversality condition, to the incorporation of constraint equations, to other necessary conditions for extrema, to the problems of Bolza, Mayer and Lagrange, and finally to the bounded and unbounded control problems. In addition to providing the basis for formulating this class of problems, the monograph is intended to serve as a necessary introduction to subsequent discussions of the optimization problem. Author

N68-15194# Grumman Aircraft Engineering Corp., Bethpage, N. Y. Research Dept.
GROUPING OF EXPERIMENTS FOR APOLLO APPLICATIONS: A PROGRAM
L. Aronowitz, K. Foreman, G. McCoyd, J. Scanlon, and M. Sidran Dec. 1967 33 p refs
(RM-396)

On the APPS-A mission, astronaut-monitored meteorological experiments will be performed from a modified LM in earth orbit. Experiment groupings have been established on the basis of interdependence of the experiments. Each experiment has been rated according to its over-all flight readiness, and a priority listing obtained. The millimeter wave propagation equipment and the microwave radiometers were found to satisfy the chosen criteria most satisfactorily. A number of specific problem areas were studied, including the effects of RCS gases and charged particles on the instruments. Trajectory requirements of the different experiments

were examined for compatibility. A circular orbit at 175 n.m. altitude and 50° inclination appears favorable to the mission objectives of nearly all experiments and acceptable to the remainder. Author

N68-15201# Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany). Institut fuer Geophysik und Meteorologie.
SCIENTIFIC UNDERTAKINGS OF THE AERONAUTICAL MISSIONS TO JUPITER [DIE WISSENSCHAFTLICHEN AUFGABEN VON RAUMFLUGMISSIONEN ZUM JUPITER]
F. M. Neubauer [1967] 22 p refs In GERMAN

The following scientific studies are proposed for Jupiter missions: (1) *Magnetic Field, Magnetosphere, and Ionosphere*—radiation fields measurements inside Jupiter magnetopause, measurements of proton fluxes, and height profiles of thermal Jupiter plasma; (2) *Neutral Atmosphere*—temperature structure, chemical composition, trace elements, and elements necessary for living organisms; (3) *Jupiter Interior*—gravity point determination, and pressure-density measurements to determine gravity potential; and (4) *Satellites, and Small Bodies In Jupiter Vicinity*—photometric measurements. Transl. by G.G.

N68-15266# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
FLIGHT MECHANICAL PROBLEMS OF AERODYNAMIC SPACE VEHICLES [FLUGMECHANISCHE PROBLEME AERODYNAMISCHER RAUMFLUGKOERPER]
W. Brunn, W. Engler, W. Hein, H. Kellermeier, P. Liu et al Bad Godesburg, W. Ger. Bundesmin. fuer Wiss. Forsch. Jul. 1967 45 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-15)

Flight mechanical and thermodynamic problems of reusable launch systems have been investigated using a two-stage aerospace transporter in piggy-back arrangement as a typical example. Ascent trajectories were selected according to minimum fuel consumption. The governing parameter for reentry trajectories is aerodynamic heating. In addition, certain minimum requirements have to be met with respect to mechanical loads and the dynamics of aerodynamic flight. For both ascent and descent trajectories major trends were determined by utilizing analog and digital computers. Author

N68-15268 Technische Hochschule Carolo Wilhelmina, Brunswick (West Germany).
A SPACE PROBE TO JUPITER. AIMS AND POSSIBILITIES FOR THE REALISATION IN THE FEDERAL REPUBLIC OF GERMANY [EINE RAUMSONDE ZUM JUPITER ZIELE UND MOEGLICHKEITEN ZUR VERWIRKLICHUNG IN DER BRD]
F. M. Neubauer Bad Godesberg, (W. Ger.) Bundesmin. fuer Wiss. Forsch. Aug. 1967 67 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-20)

The following study on the aims and possibilities of a space probe to Jupiter was stimulated by the "Fachgruppe I" of the German Commission for Space Research (conference held on February 25, 1966 at Bad Godesberg). In the first section the present picture of Jupiter is presented. It is because of the large amount of material, which has especially increased in the last years, that this presentation can only be brief. In addition the characteristics of the asteroid belt are described briefly. The fields, in which observations are desired, are pointed out. The second section contains reports on discussions and the correspondence with several German research establishments. In the third section several missions to Jupiter are proposed using the proposals of the experimentators and taking into account the importance of the observations. The study is concluded by a short summary. Author

N68-15307# Royal Aircraft Establishment, Farnborough (England).
ORBITAL PARAMETERS OF SAMOS 2 (1961 A 1) FOR MAY–AUGUST 1963
R. H. Merson, Dawn Y. Ewers, and D. G. King-Hele Apr. 1967 17 p refs
(RAE-TR-67082) CFSTI: HC $3.00/MF $0.65

534 visual observations of the satellite Samos 2 have been used to determine its orbit at intervals of 50 nodes from 28 April–12 August 1963. The orbit was previously determined for shorter periods in 1961 and 1962. The satellite was observed over only 6% of its orbit at most, making analysis difficult. About 30% of the observations were rejected, 12% coming from three French stations. Author (ESRO)

N68-15313* National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
OPTIMAL PAYLOAD TRAJECTORY CHARACTERISTICS FOR WINGED BOOSTER VEHICLES
Jarrel R. Elliott and Timothy R. Rau 1967 14 p refs Presented at the AIAA Guidance, Control, and Flight Dyn. Conf. Atmos. Flight Mech. Session, Huntsville, Ala., 14–16 Aug. 1967
(NASA-TM-X-60325) CFSTI: $3.00 CSCL 22C

The results of an analysis in which optimal lifting trajectories of a hypothetical two-stage winged space launch vehicle are compared with nonlifting trajectories for the same vehicle are presented. Fixed geometry wings of various planform areas and weights were added to a basic vehicle of the Saturn V class to arrive at a winged boost-launch system. A horizontal launch take-off mode, which considered the effect of a ground-based acceleration sled, was studied in addition to the conventional vertical launch mode. Author

N68-15420# Bolkow Entwicklungen K. G., Munich (West Germany).
THE SIGNIFICANCE OF THE JUPITER SWINGBY MODE FOR INTERPLANETARY MISSIONS [DIE BEDEUTUNG DER SWINGBY-TECHNIK AM PLANETEN JUPITER FUER INTERPLANETARE MISSIONEN]
Walter Mueller [1967] 60 p refs In GERMAN Presented at DGRR Symp. on Interplanetary Aeron. Missions, Munich, 7 Dec. 1967
(RF-85-0)

The astrodynamic theory of gravity-assisted interplanetary spacecraft trajectories is discussed, followed by an analytical study of Saturn, Uranus, Neptune, and Pluto missions with gravity assists from Jupiter. Time factors, launch opportunities, and reduced propulsion requirements due to the utilization of the gravity field are covered. Transfer trajectories utilizing several gravity fields for a multiple interplanetary mission are considered as well as solar missions and missions to comets. Problems connected with scientific purpose, trajectory accuracy, and mission duration are briefly pointed out. Transl. by K.W.

N68-15424*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
CATALOG OF PRECISELY REDUCED OBSERVATIONS
9 Nov. 1967 183 p refs *Its* Catalog P-16
(Grant NsG-87-60)
(NASA-CR-92585; SAO Special Rept.-256) CFSTI: HC $3.00/MF $0.65 CSCL 22A

Tables are presented which list the positions of artificial satellites as obtained from the precise reduction of the films taken at the 12 Baker–Nunn camera stations. The catalogue, which covers three months of observations on satellites, includes all precisely reduced observations made during that period that have been checked and found to be without significant errors. B.S.D.

N68-15484*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SIMULTANEOUS CORRECTION OF VELOCITY AND MASS BIAS IN PHOTOGRAPHY OF METEORS
C. D. Miller Washington Feb. 1968 74 p refs
(NASA-TR-R-280) CFSTI: HC $3.00/MF $0.65 CSCL 03A

An analysis was made to investigate the magnitude of the weighting factor, specifically for application to photographic meteor data. As a result, a revised factor was obtained to operate upon actual counts of photographic meteors within various classes of velocity to provide a correct ratio of counts for all velocities reduced to any given lower mass limit. An expression was derived theoretically for maximum effective exposure on the photographic plate produced by a meteor in terms of the original mass of the particle, its velocity relative to earth's atmosphere, and the angle of its path to the zenith. The expression for maximum effective exposure was tested and revised by application to 100 test meteors that were believed to have provided approximately uniform effective exposure density. The revised expression for maximum effective exposure was combined with a widely accepted equation for the influx rate of meteors of mass greater than a stated value to obtain approximately the desired weighting factor. The analysis indicated a large change in value of the exponent of velocity relative to earth's atmosphere in the weighting factor, namely, from −2 downward at least to −3.85 and possibly as low as −4.22.
Author

N68-15501*# Bendix Corp., Ann Arbor, Mich.
LUNAR SURFACE MOBILITY SYSTEMS COMPARISON AND EVOLUTION STUDY (MOBEV) Final Report
Nov. 1966 186 p
(Contract NAS8-20334)
(NASA-CR-92641; BSR-1464) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A methodology is presented which was developed to enable a mission planner to select a vehicle evolution covering a broad mission spectrum for the 1970 to 1980 period. Resources and technical data are included on the rovers (manned and unmanned) for exploration, site survey, and base support operations, and on the flyers for open cockpit manned operations and rescue and exploration missions. The feasibility of Apollo spacecraft derivatives for mobility application is considered.
N.E.N.

N68-15508*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
AN ANALYSIS OF MARTIAN PHOTOMETRY AND POLARIMETRY
James B. Pollack and Carl Sagan 29 Nov. 1967 106 p refs
(Grant NGR-09-015-023)
(NASA-CR-92580; SAO Special Rept.-258) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The physical parameters that influence the photometric and polarimetric properties of a solid are enumerated and used to guide a comparison of laboratory measurements with observations of Mars. Both the bright and dark areas of Mars are found to be covered by a fine powder. Furthermore, they appear to have a very similar chemical composition. It is argued that geothite is a major constituent of both regions. The particles on the bright areas are characterized by an average particle radius of 25μ, while those on the dark areas have a mean size of 100μ outside of the period of seasonal darkening and about 200μ near the peak of the darkening. The seasonal darkening of the dark areas is the result of a change in the average particle dimension without an accompanying chemical change. The Martian atmosphere has much less influence on the photometric and polarimetric observations than was previously supposed. The observed lack of contrast in the blue appears to be largely the result of an intrinsic loss of surface contrast, and not an effect of a hypothetical atmospheric blue haze.
Author

N68-15550*# Physics, Engineering, Chemistry Corp., Boulder, Colo.
STUDY OF RADIATIVE ASPECTS OF LUNAR MATERIALS Final Report, 26 Apr. 1966–26 Jan. 1967
Donald G. Burkhard and Neil Ashby 26 Jan. 1967 121 p refs
(Contract NAS8-20385)
(NASA-CR-61481) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Numerous numerical calculations are presented, based on a photometric function which appears to represent observations of lunar surface radiance as a function of angle of incidence, angle of observation, and phase angle. The function has two adjustable parameters: the normal albedo, and a compaction parameter which represents roughly the degree of porosity of the lunar surface. Tables are included from which may be obtained the total energy reflected per cm^2 per min into all angles, from a surface feature of known normal albedo and compaction parameter, at any given angle of illumination from the sun. Based on a model of the rough lunar surface, derivations of the photometric functions considered for numerical calculations are presented. A heuristic argument leading to a mathematical expression for the infrared radiation emitted from the lunar surface is offered. Comparisons with experimental data are made. Tables of the calculated emitted energy are given for angles of incidence 80°, 60°, 30°, and 0°, for angles of observation every 5° from 0° to 85°; and for azimuthal angles between incident and observed rays every 15° from 0° to 180°.
M.G.J.

N68-15559 Entwicklungsring Sud, Munich (West Germany).
THE CAPTURE AND ESCAPE BEHAVIOUR OF PLANET/MOON SYSTEMS [DAS EINFANG- UND KATAPULTVERMOEGEN VON PLANET/MOON SYSTEMEN]
O. Bschorr and A. Leibold 1967 40 p refs In GERMAN; ENGLISH summary Presented at the Symp. Interplanet. Space Flight Mission, Muenchen, 1967
(EWR-SB-17-67)

The flyby behaviour for planet/moon systems is investigated. The velocity gains and the conditions for capture and escape are calculated. A flyby mode in the Jupiter/Ganymede-system yielded an impulse reduction of 4.5 km/sec.
Author

N68-15566# Air Force Cambridge Research Labs., Bedford, Mass. Space Physics Lab.
BIBLIOGRAPHY OF LUNAR AND PLANETARY RESEARCH, SUPPLEMENT NO. 2-1966
J. W. Salisbury, ed., J. E. M. Adler, J. P. Dybwad, G. R. Hunt, L. B. Ronca et al Sep. 1967 235 p refs *Its* Spec. Rept. No. 67
(AFCRL-67-0518; AD-662876)

A bibliography of lunar and planetary research articles published during 1966 is presented with both subject and author listings. The major subject categories are: astrobiology, comets, meteorite craters and cratering effects, meteors and meteorites, the moon, origin of the solar system, the planets, and tektites. Each article is abstracted.
Author (TAB)

N68-15573*# Southwest Center for Advanced Studies, Dallas, Tex.
ENVIRONMENT FOR MANNED PLANETARY MISSIONS
Francis S. Johnson [1967] 5 p refs
(Grant NsG-269)
(NASA-CR-92511) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The radiation hazard in space is discussed in terms of Van Allen radiation and solar flare proton radiation; radiation presents

a significant hazard but it is apparently tolerable if shielding is as great as 10 g cm^{-2}. The meteorite hazard is comparable; penetration is unlikely if the wall thickness corresponds to mass densities as high as those required for radiation shielding. Neither Mars nor Venus has a magnetosphere like that of earth, and hence no radiation belt; however, both have induced magnetospheres. The atmosphere of Mars is so thin as to complicate the landing problem there. The atmosphere of Venus is very thick; recent observations in Mariner 5 and Venus 4 permit a more detailed description of the atmosphere of Venus than that of Mars. Author

N68-15618# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DETERMINATION OF PHYSICAL PARAMETERS OF THE ATMOSPHERE OF THE SUN BY THE METHOD OF CURVES OF GROWTH [OB OPREDELENII FIZICHESKIKH PARAMETROV ATMOSFERY SOLNTSA METODOM KRIVYKH ROSTA]

D. M. Kuli-Zade *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 207–220 refs (See N68-15601 06-23)

A statistical method utilizing equivalent Fraunhofer line widths (called curves of growth method) was used to analyze the solar atmosphere. The effect of statistical dispersion in the relative oscillator forces caused by experimental error was studied, and the physical parameters of the solar atmosphere were determined. The relative magnitude of the gf-lines of Fe I were used to construct the curves of growth. It was shown that parameters are not sensible to statistical dispersions in the determination of the relative gf-values of the Fe I lines, and that they do not practically depend on the adopted model of the solar atmosphere. L.S.

N68-15659# American Science and Engineering, Inc., Cambridge, Mass.

RECENT DEVELOPMENTS IN X-RAY ASTRONOMY

H. Gursky Paris ESRO Nov. 1967 52 p refs Presented at the ESLAB/ESRIN Symp. on Satellite Meas. of Corpuscular Radiation from Outer Space, Noordwijk, Holland, 10–14 Jul. 1967
(ESRO-SN-77) CFSTI: HC$3.00/MF$0.65

In describing the advances that have been made in X-ray astronomy during the past two years, the author discusses the location and distribution of known or suspected X-ray sources and describes measurements that have been made on individual sources and background. Recent advances in instrumentation techniques are summarized, particularly those associated with the reduction of the non X-ray portion of the background, new developments in the use of modulation collimators and the use of grazing-incidence telescopes. The restrictions imposed by the various vehicles (balloons, rockets, satellites) are outlined and the importance of using controlled vehicles is stressed. Problems of data analysis are raised with particular reference to their dependence on vehicle attitude. In conclusion, the author suggests possible future investigations in X-ray astronomy that could be carried out with even modest instrumentation. Author (ESRO)

N68-15662*# GCA Technology Div., GCA Corp., Bedford, Mass.

RADIATIVE TRANSFER AND THE THERMAL STRUCTURE OF PLANETARY ATMOSPHERES

George Ohring Nov. 1967 37 p refs Presented at the Survey Symp. on Radiation at the 14th Gen. Assembly of the Intern. Union of Geodesy and Geophys., 25 Sep.–7 Oct. 1967
(Contract NASw-1574)
(NASA-CR-92542; GCA-TR-67-16-N) CFSTI: HC $3.00/MF $0.65
CSCL 03B

The mean surface temperature and mean vertical distribution of temperature of a planetary atmosphere are, to a large extent, determined by radiative processes. Given the basic physical characteristics of the planetary atmosphere, such as composition, surface pressure, and albedo, it is possible, through the application of radiative transfer theory to compute the temperature structure of the planetary atmosphere. For the Earth's atmosphere the problem has been to determine theoretically the mean vertical temperature profile from the surface up to the thermosphere. An additional problem, related to climatic change, is the effect of changes in the basic physical characteristics, such as composition or cloudiness, on surface and atmospheric temperatures. Applications of radiative transfer theory to the atmospheres of the other planets have been aimed at deriving estimates of surface and atmospheric temperatures on Mars and estimates of the greenhouse effect on Venus. The theoretical models and results of recent studies of these topics are reviewed in the present survey paper. Author

N68-15666# European Space Research Organization, Paris (France).

FEASIBILITY STUDY OF A SATELLITE FOR THE OBSERVATION OF IONOSPHERIC IRREGULARITIES

F. Mariani (Rome Univ.), G. Wrenn (Univ. Coll., London), A. Pedersen (European Space Res. Lab.), H. Marin (European Space Technol. Center), and R. Pacault (European Space Technol. Center) Aug. 1967 47 p
(ESRO-SP-24) CFSTI: HC$3.00/MF$0.65

This report is the outcome of a feasibility study on a satellite for the investigation of the extent and temporal and spatial variations of ionospheric irregularities, in terms of all relevant parameters. This involves measuring the density, temperature and composition of the neutral and ionised atmosphere at a very high sampling frequency. Measurements of the time variation of solar photon radiation and of particle fluxes are proposed, together with an investigation of the time and space variations of the magnetic and electrical fields, from which information about excitation mechanisms of irregularities can be obtained. In all, twelve experiments are proposed with the above objectives in mind. Arguments are put forward for the adoption of either a polar or low-inclination orbit, and the final choice is left open for further study. The possibility of using a retro-rocket system to step down the spacecraft into successively lower circular orbits is discussed, as is the use of a small piggy-back satellite to yield information on spatial variations and to make possible some short-path radio propagation experiments. The possibility of using an on-board computer for data handling is also discussed. Author (ESRO)

N68-15680# Dornier-Werke G.m.b.H., Friedrichshafen (West Germany).

DAMPING SYSTEMS OF GRAVITATIONALLY STABILIZED SATELLITES [DAEMPFUNGSSYSTEME SCHWEREFELD-STABILISIERTER SATELLITEN]

W. Wolber Bad Godesberg, West Ger. Bundesmin. fuer Wiss. Forsch. Jul. 1967 50 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-13)

An orbiting extended satellite is submitted to gravity and centrifugal forces, which try to align its axis of minimal moment of inertia into the direction of gravity gradient. Consequently the satellite oscillates about this direction. In this paper possibilities of damping such oscillations are investigated. The bases of dynamics are discussed as far as necessary for the development of a damper. After analyzing existing systems new possibilities are investigated. Thereby an inductive damper yields the best results. Author

N68-15683*# Planning Research Corp., Washington, D. C.

INTRODUCTION TO THE DERIVATION OF MISSION REQUIREMENTS PROFILES FOR SYSTEM ELEMENTS

NASA 1967 91 p refs
(Contract NASw-1032)
(NASA-SP-6503) CFSTI: HC $3.00/MF $0.65 CSCL 22A

The present report describes a methodology for deriving the mission requirements profiles of the subsystem and lower level hardware elements from the system profile. This methodology consists of: (1) identification of the parameters that relate the functions and operations of the lower elements to each specific function and operation of the overall system; (2) arrangement of the parameters in the order of their importance to that function and operation of the system (so that they can each be treated in accordance with the appropriate priority and allocation of resources); (3) resolution, through the selection and application of the most appropriate analytical or empirical techniques, of the influences of each parameter from the system level to the level of the element under consideration; (4) compilation of the parameters and their influences derived in this manner into the mission requirements profile for the element in question. The appendices to this document are devoted to the presentation of supplementary data regarding parameters and analytical techniques necessary for the implementation of the methology. Author

N68-15705*# Data Dynamics, Inc., Los Angeles, Calif.
INVESTIGATION OF X-RADIATION OF THE MOON BY MEANS OF THE LUNAR SATELLITE "LUNA-10"
S. L. Mandelshtam, I. P. Tindo, and V. I. Karev [1967] 15 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 6, 1966 p 827–837 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92597) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The calculations of intensity of characteristic fluorescent lines of silicon, aluminum and magnesium in the surface layer of lunar rock formations, stimulated by solar X-radiation are given. Instrumentation installed on the lunar satellite "Luna-10" and used for the experimental discovery of lunar X-radiation is described. This paper includes the results of measurements of the level of the cosmic background in the vicinity of the Moon and of electrons of the "tail" of the Earth's magnetosphere with an energy of more than 40 kev. Preliminary data on the registration of X-radiation is given. Author

N68-15706*# Data Dynamics, Inc., Los Angeles, Calif.
ON THE APPLICATION OF A METHOD OF DYNAMIC FILTRATION TO PROBLEMS OF DETERMINING TRAJECTORIES FOR SPACECRAFT
B. A. Reznikov [1967] 17 p refs Transl. into ENGLISH from Kosmich. Issled. (Moscow), v. 4, no. 4, 1966 p 536–544 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92598) CFSTI: HC $3.00/MF $0.65 CSCL 22C

Comparative characteristics of various methods for constructing algorithms for processing of measurement information during the determination of trajectories of spacecraft, are given in this paper. The possibility of constructing new types of algorithms by means of a method of dynamic filtration, are considered. The properties of these algorithms are investigated. Author

N68-15722*# National Aeronautics and Space Administration, Washington, D. C.
SPACE DEVELOPMENT IN JAPAN
Kankuro Kaneshige Jan. 1968 15 p Presented at Productivity Club, Tokyo, Sep. 1967
(NASA-TT-F-11531) CFSTI: HC $3.00/MF $0.65 CSCL 22A

An overview of space-related developments in Japan is presented, and a general discussion covers world space activities and defines both space and space research. Activities of the Space Science and Technology Advisory Committee and the National Space Activities Council are included. Benefits accruing from expenditures for space development and technology are assessed, and the need to improve the level of technology is noted. M.W.R.

N68-15723*# North American Rockwell Corp., Downey, Calif. Space Div.
DEFINITION OF EXPERIMENTAL TESTS FOR A MANNED MARS EXCURSION MODULE. VOLUME 4: BRIEFING BROCHURE
G. S. Canetti Nov. 1967 205 p
(Contract NAS9-6464)
(NASA-CR-92561; SID-67-755-4, V. 4) CFSTI: HC $3.00/MF $0.65 CSCL 22B

A one-year study to develop a preliminary conceptual design, determine requirements, and formulate a test program for Mars exploration missions of the 1980's is summarized. This briefing to present the highlights of the program is divided into sections on ground rules, mission profile, recommended design, test and development, schedules and costs, and technological implications. Consideration is given to weight heat shield, propulsion parameters, landing, and subsystems for a 4-man 30-day mission. Available parking orbit inclinations, deorbit and entry, entry and ascent requirements and typical mission abort penalties are discussed. M.W.R.

N68-15724*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
MARS ATMOSPHERE DEFINITION—VOYAGER SPACECRAFT Final Report
Jan. 1968 108 p refs
(Contract NAS8-22603)
(NASA-CR-61185) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A model of the Martian atmosphere is presented, based on a survey of literature and data gathered by Voyager and Mariner IV spacecraft. Mean and extreme values of physical data were determined. Data on atmospheric composition, pressure, temperature, and winds are summarized. The near surface atmosphere is expected to be CO_2 rich and have a pressure of less than 25 mb. Results of studies on latitudinal and seasonal variations indicate that at 100 km the density may vary by 65% from the equator to 60 degrees latitude, and the tropopause altitude variation to be 75%. Data on the thermosphere and on the atmospheric structure as a function of solar activity are outlined. The white and yellow clouds appear to have preferred regions and preferred time periods. From chemical kinetics and composition studies, a steady-state atmosphere is predicted, with concentrations of eighteen species as a function of altitude. It was found that above 60 km, CO_2 is more than 50% dissociated and CO and O become the major constituents. N.E.N.

N68-15725*# Boeing Co., Seattle, Wash.
LUNAR ORBITER 3: PHOTOGRAPHY
Washington NASA Feb. 1968 128 p
(Contract NAS1-3800)
(NASA-CR-984; D2-100753-2, V. 2) CFSTI: HC $3.00/MF $0.65 CSCL 22A

A description of Mission III planning, its conduct with respect to photography, and an analysis of the photographic results are presented. Data pertinent to analysis and interpretation of the photographs are included. The telephoto coverage provided resolution equivalent to 1 meter from a nominal altitude of 46 kilometers. In addition to normal near-vertical photography, photographs were obtained with convergent telephoto stereo coverage. Oblique-angle photography was employed to enhance interpretation of topographic features, to provide photographs of areas beyond the field of view

of a vertical camera orientation, and to investigate photometric characteristics of the lunar surface. Operation of the cameras was satisfactory and high-quality photographs were obtained. By combining priority and final readouts, 82.8% of the planned primary-site, wide-angle coverage and 70.3% of the telephoto coverage was obtained. Author

N68-15729# European Space Research Organization, Paris (France).
FEASIBILITY STUDY OF A JOINT THREE-SATELLITE PROJECT FOR THE INVESTIGATION OF MAGNETOSPHERIC IONOSPHERIC PHENOMENA
J. Ortner (European Space Res. Lab.), A. Pedersen (European Space Res. Lab.), G. Pizzella (Rome Univ.), H. Marin (European Space Technol. Center), R. Pacault (European Space Technol. Center) et al Aug. 1967 76 p
(ESRO-SP-21) CFSTI: HC $3.00/MF $0.65

The main objective of the three-satellite project is to relate changes in the solar wind with their effects on the magnetosphere and high-latitude ionosphere. A highly eccentric orbit satellite is proposed with its apogee at 30 earth radii above the North Pole to study the solar wind. The payload should include experiments to measure the composition, density and velocity of the solar plasma, magnetic and electric fields and energetic particles. An intermediate orbit satellite is proposed with an apogee of about 18 earth radii in the tail of the magnetosphere. The experiments will be similar to those flown on the highly eccentric orbit satellite. It should be possible to detect rapid variations of the magnetic and electric fields. Extensive studies of particles are of particular importance in the magnetospheric tail. Finally, a low orbit polar satellite is proposed with an apogee of 1500 km. The main aim will be to make observations of energetic particles (with high spatial resolution) and of their effects upon the ionosphere. Emissions from the atmosphere and from aurorae, composition and density of neutral as well as ionised constituents, should also be studied. High-resolution measurements of magnetic and electric fields and VLF noise measurements are of particular importance. Author (ESRO)

N68-15741*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 6: THE N-BODY PROBLEM AND SPECIAL PERTURBATION TECHNIQUES
M. S. Allione, A. L. Blackford, J. C. Mendez, and M. M. Whittouck Washington NASA Feb. 1968 122 p refs
(Contract NAS8-11495)
(NASA-CR-1005; SID-65-1200-6) CFSTI: HC $3.00/MF $0.65 CSCL 22C

The analytical formulations and the numerical integration methods available for the solution of the n-body problem are discussed. For large pertubative accelerations which are changing rapidly, the Cowell method of mathematical formulation is preferred. For phases of the flight where the force field is nearly conservative and/or nearly central with respect to the body, either Encke's method or the variation of parameters is recommended. Multistep predictor-corrector methods are considered to be significantly more efficient than other numerical integration techniques. The Gauss-Jackson method is suggested for general application, with the Adams-Moulton predictor-corrector method as a close alternate. The Lanczos and Nordsieck methods are classified as new and promising. The single-step Runge-Kutta method is considered desirable in some cases due to its stability. The Runge-Kutta method is also recommended as a starter for the multi-step methods. N.E.N.

N68-15748*# National Aeronautics and Space Administration, Washington, D. C.
SIGNIFICANT ACHIEVEMENTS IN SPACE SCIENCE 1966
1967 224 p refs
(NASA-SP-155) GPO: $1.50 CSCL 03A

Scientific and technological advances are reported for the areas of space astronomy and bioscience, ionospheres and radio physics, particles and fields, planetary atmospheres and planetology, and solar physics. Considered to be among the year's highlights are the soft landing of Surveyor I and the photographs obtained by Lunar Orbiters I and II. Special mention is made of Explorer XXXIII's extended flight, the upper atmospheric data obtained by Explorer XXXII, and the interplanetary measurements taken by Pioneer VII in heliocentric orbit. N.E.N.

N68-15763*# California Univ., Berkeley. Space Sciences Lab.
ON THE ORIGIN OF THE SOLAR SYSTEM
H. Alfven Nov. 1967 66 p refs Presented at Space Sci. Colloq., Berkeley, Calif., Nov. 1967 /its Ser. No. 8, Issue No. 105
(Grants NsG-243; NGR-05-003-230; Nonr-3656(28))
(NASA-CR-92575) CSCL 03A

Magnetohydrodynamic contributions to the birth of planets and satellites, space research findings on the behavior of magnetized plasmas, and celestial mechanics advances are considered in relation to the origin of the solar system. Following a general introduction and basic principles, attention is given to the accretion of planets, partial co-rotation of a magnetized plasma, and the structure of Saturnian rings. The introduction deals with the state of the solar system at the end of the cosmogonic process, spin of celestial bodies, orbital elements, planetesimal agglomeration, cosmogonic plasma, plasma processes, and planetary versus satellite systems. Isochronism and Giuli's theory of accretion are discussed; as are Ferraro isorotation and partial co-rotation, plasma in a magnetic dipole subjected to gravitation, stationary motion of magnetic plasma, finite temperature effect, and plasma condensation. Resonance theory of the ring structure, cosmogonic theory of Saturnian rings, discovery of Janus, and cosmogonic shadow effects are also discussed. M.W.R.

N68-15783*# National Aeronautics and Space Administration, Manned Spacecraft Center, Houston, Tex.
A COMPUTER PROGRAM FOR CALCULATING MODEL PLANETARY ATMOSPHERES
David E. Pitts Washington Feb. 1968 63 p refs
(NASA-TN-D-4292) CFSTI: HC $3.00/MF $0.65 CSCL 03B

The computer program presented here enables calculations to be made of a model atmosphere of a planet to one planetary radius above the surface. The variables calculated are altitude, temperature, pressure, density, specific weight, molecular weight, pressure scale height, density scale height, number density, mean particle velocity, mean free path, collision frequency, speed of sound, coefficient of viscosity, kinematic viscosity, and columnar mass. The calculations are usually made for atmospheres consisting of nitrogen, carbon dioxide, oxygen, argon, neon, hydrogen, helium, water vapor, carbon monoxide, and sulfur dioxide. However, if the printouts of mean free path, collision frequency, coefficient of viscosity, and kinematic viscosity are ignored, calculations may be made for gases of any desired molecular weight. Author

N68-15816# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
PRINCIPLES OF THE THEORY OF ROCKET FLIGHT
A. A. Dmitriyevskiy and V. N. Kashevoy 5 Sep. 1967 251 p refs Transl. into ENGLISH of the book "Osnovy Teorii Poleta Raket" Moscow, Voyenizdat., 1964 p 1-311
(FTD-MT-65-567; AD-662757)

The book discusses basic questions of the theory of the flight of controlled and unguided rockets of different assignment and the influence of their design and construction on conditions of flight. Consideration is given to the following forces and moments having an effect on the rocket in flight: tractive force (thrust), force of weight, control forces and moments, aerodynamic drag. The theoretical and experimental determination of aerodynamic coefficients is described, as well as the character of their change in the process of flight depending upon altitude and meteorological factors. The phenomena accompanying the flight at great heights and the phenomenon of aerodynamic heating are discussed. The basic positions of the theory of rocket flight are examined. Fundamental information is given on the formulation of equations of motion and the calculation of characteristics of trajectories of the flight of controlled and unguided rockets of different assignment. The concept on the establishment of optimum conditions of motion and the calculation of trajectories according to data of radar observations are discussed. Different methods of stabilizing rockets in flight and factors affecting the deviation of the rocket from the calculated trajectory are investigated. The causes of dispersion during firing by the rockets and the methods of decreasing the dispersion are explained. TAB

N68-15891*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
SUMMARY OF GEMINI EXTRAVEHICULAR ACTIVITY
Reginald M. Machell, ed. Washington 1967 336 p refs
(NASA-SP-149) CFSTI: HC$3.00/MF$0.65 CSCL 22A

The actual systems employed, the testing and qualifications of these systems, the preparation of the flight crews, and the operational and medical aspects were described from a developmental viewpoint. During the Gemini program, the basic feasibility of extravehicular activity was established. Other significant results were: (a) demonstration of retrieval of equipment from within the spacecraft adapter and from another satellite, (b) establishment of requirements for handholds, foot restraints, and body restraints, (c) evaluation of the dynamics of motion on a short tether, (d) preliminary evaluation of a hand held maneuvering device, (e) demonstration that the extravehicular workload could be maintained within the limits of the life support system and the capabilities of the pilot, and (f) demonstration that underwater zero-g simulation was valid in solving body restraint problems and in assessing workloads. The most significant limitations were the inability to perform extravehicular tasks without the proper body restraints, the mobility restrictions imposed by the design of the space suit, and the limited cooling capacity of life support systems using gaseous cooling. Recommendations are made for development of future extravehicular operations. Author

N68-15973*# State Univ. of Iowa, Iowa City. Dept. of Physics and Astronomy.
JUPITER'S MAGNETOSPHERE
J. H. Piddington Sep. 1967 49 p refs
(Grant NsG-233-62)
(NASA-CR-92559; Rept.-67-63) CFSTI: HC $3.00/MF $0.65 CSCL 03B

Alternative types of Jupiter upper atmospheres are discussed, and it is shown that a hot extensive ionosphere and dense magnetosphere may result from electromagnetic heating which also accounts for an apparent excess of thermal radiation. The disturbance caused by the satellite Io through the magnetosphere may be far more violent than previous estimates, if the satellite has finite electrical conductivity. It will then carry field lines frozen into its body and cause a disturbance (a forced interchange motion) extending to the extending to the ionosphere in both hemispheres. There is evidence that this model accounts for all the Io related decametric radiation in terms of a single complex source lying near longitude λ_{III} 200° and radiating in more than one direction. The study indicates that near Jupiter there will be an even richer field of particles and magnetic phenomena, caused mainly by the planet's rotation. Author

N68-16025* California Univ., San Diego.
THE GENERATION OF RADIO SOURCES. 1: OBSERVATIONAL PROPERTIES TO BE EXPLAINED
Geoffrey Burbidge [1967] 24 p refs Sponsored in part by NSF
(Grant NsG-357)
(NASA-CR-91807) CFSTI: $3.00 CSCL 03B

The shapes and brightness distributions of extragalactic radio sources orginating in galaxies and in quasi-stellar objects, are discussed. The bulk of the radiation appears to be emitted by the synchrotron process. The double character and small component features of the radio sources are described. A mathematical model capable of explaining the existence of small high surface brightness sources which are found far from the explosion center is presented; and the mechanism of ejection is discussed. L.S.

N68-16038 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE QUESTION ABOUT SOURCES OF OPACITY OF ATMOSPHERES OF STARS OF LATE SPECTRAL CLASSES [K VOPPROSU OB ISTOCHNIKAKH NEPROZRACHNOSTI ATMOSFER ZVEZD POZDNIKH SPEKTRAL'NYKH KLASSOV]
V. G. Buslavskiy *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 137–150 refs (See N68-16026 08-23)

The author used computed values of several possible sources of opacity in the atmospheres of late types stars to show that the major absorber of light in a hydrogen stellar atmosphere in thermodynamic equilibrium at T = 3000K is Rayleigh scattering on atoms of pure hydrogen and molecules of hydrogen. In a stellar atmosphere containing a metal such as sodium, the major opaqueness source in the 2000–4000K temperature range is absorption by negative hydrogen ions and atoms of metal. The numerical data used to justify these conclusions are tabulated. The results on atmospheres containing metal will be used for construction of atmospheric models for cold stars. Author

N68-16085* Stanford Univ., Calif. Radioscience Lab.
RESEARCH AT THE STANFORD CENTER FOR RADAR ASTRONOMY Semiannual Status Report, 1 Jul.–31 Dec. 1967
V. R. Eshleman Jan. 1968 18 p refs
(Grant NsG-377)
(NASA-CR-92563; SASR-10) CFSTI: $3.00 CSCL 03A

Mariner 5 radio occultation measurements of the ionosphere and atmosphere of Venus were among the activities conducted, and immersion measurements revealed a tail of plasma on the dark side of Venus. No diffraction type signatures were evident in the amplitude data, and it appears that the lower atmosphere of Venus is super-refractive. Mention is made of the launching of Pioneer 8, and it is noted that one of the difficulties in interpreting both Pioneer and Mariner data has been the inability to measure the contribution of the earth's ionosphere. Bistatic radar data reduction from Lunar Orbiter and Mariner 5 is underway, and contributions by various graduate students are summarized. M.W.R.

N68-16103*# North American Aviation, Inc., Downey, Calif.
GUIDANCE, FLIGHT MECHANICS AND TRAJECTORY OPTIMIZATION. VOLUME 1: COORDINATE SYSTEMS AND TIME MEASURE

M. B. Tamburro, A. S. Abbott, and G. E. Townsend Washington NASA Feb. 1968 115 p refs
(Contract NAS8-11495)
(NASA-CR-1000; SID-65-1200-1) CFSTI: HC $3.00/MF $0.65 CSCL 22C

A complete description of a coordinate measuring system to determine particle position and velocity is given. Emphasis is placed on the coordinate frameworks utilized for trajectory problems and body oriented axis systems. Developed is a mathematical model that derives the equations of motion from the fundamental reference system of the moon orbit around the earth and finds solutions to yield the nutation and precession corrections to the basic reference frame. Finally, discussed are time standards employed in astronomical studies for the purpose of relating the rotating coordinate systems to measurements of celestial spheres. G.G.

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N68-15024# Deutsche Gesellschaft fur Raketentechnik und Raumfahrt, Stuttgart (West Germany).
PAYLOAD PROPOSAL FOR AN INTERPLANETARY PROBE FOR PERIHELION MEASUREMENT [NUTZLASTVORSCHLAG FUER EINE INTERPLANETARE SONDE FUER SONNENNAHE MESSUNGEN]
Herbert Porsche 1967 11 p refs In GERMAN Presented at DGRR-Symp "Interplanetare Raumflugmission", Munich, 7 Dec. 1967

Considered is the use of an Atlas Centaur launch vehicle for an ecliptic mission reaching considerably past the Venus orbit. It is estimated that such a launch vehicle system is capable of delivering a 150 kg payload into an elliptic orbit around the sun with the perihelion at 0.3 astronomical units. Radio blackout regions for the mission are shown. Eight experiments for the probe are briefly discussed. The scientific mission of the probe centers around observations and measurements of solar radiation, corpuscular phenomena, interplanetary magnetic fields, and meteoroids. Transl. by K.W.

N68-15036# National Academy of Sciences—National Research Council, Washington, D. C. World Data Center A: Rockets and Satellites.
CATALOGUE OF DATA IN WORLD DATA CENTER A: ROCKETS AND SATELLITES Semiannual Report, 1 Jan.–30 Jun. 1967
Oct. 1967 26 p refs Supported by NSF

Sounding rocket, artificial earth satellite, and space probe data received by the World Data Center, WDC-A, between January 1 and June 30, 1967, are summarized. This catalogue of rockets and satellites includes reports of launchings and observations, as well as a subject index of reports and reprints. M.W.R.

N68-15202# Entwicklungsring Nord, Bremen (West Germany).
AERONAUTICAL CONSIDERATIONS OF THE JUPITER MISSIONS [RAUMFAHRTTECHNISCHE UEBERLEGUNGEN ZUJUPITERMISSIONEN]
H. Tolle [1967] 30 p refs In GERMAN Presented at DGRR Symp. on Interplanetary Aeron. Missions, Munich, 7 Dec. 1967

Considered are propulsion energies, injection velocity, and possible launch vehicles for a Jupiter sounding mission. Projected is a 490 kp cylindrical body containing about 100 kp of scientific payload material for an 850-day space mission. The sonde will pass Jupiter at about 710 million km earth distance. A parabolic antenna will provide telemetry to the Deep Space Instrumentation Facilities and use PCM/PSK/PM modulation. A strontium 90 isotope battery will insure the necessary power supply of about 200 to 300 Watt, and a N_2O_4/N_2H_4 system with with 25 kp thrust will provide guidance impulses. Mylar insulation layers and vents will regulate temperature during flight. Transl. by G.G.

N68-15210# Bolkow Entwicklungen K. G., Munich (West Germany).
ENVIRONMENTAL TESTING OF THE THIRD STAGE OF THE EUROPEAN LAUNCH VEHICLE [DIE UMWELT-ERPROBUNG DER 3. STUFE DER EUROPAEISCHEN TRAEGERRAKETE]
Heinz Goehre 1966 34 p In GERMAN Presented at the Ann. Joint Meeting DGRR/WGLR, Bad Godesberg, W. Ger., Oct. 1966
(DGRR/WGLR Paper-66-058; Bolkow-EV-60-O) CFSTI: HC $3.00/MF $0.65

The testing of the third stage comprises development trails, type tests under intensified environmental conditions, norm tests under operational conditions. In addition, there are functional and compatibility tests during assembly and certain environmental tests with the complete rocket stage. An outline is given of the trials planning, the establishment of the test programs, the available environmental test facilities and special test installations and the conduct of the tests. Lastly, information is given on the results obtained from testing F4 and F5 flight models. Author (ESRO)

N68-15240*# National Aeronautics and Space Administration, Washington, D. C.
SPACE LAUNCH VEHICLES
Dec. 1967 8 p Supersedes NASA Facts, v. 2, no. 5
(NASA Facts-8-12-67; NASA Facts, v. 2, no. 5) GPO: HC $0.10; CFSTI: MF $0.65 CSCL 22

A NASA Facts publication of technical information on several space launch vehicles is presented. The Scout; Delta; Thor-Agena; Atlas-Agena; Atlas-Centaur; Gemini-Titan; uprated Saturn I; and Saturn V launch vehicles are covered. Height, weight, payload, number of stages, thrust, propellant used, and type of guidance system used are included in the data presented. L.S.

N68-15246*# Defense Research Corp., Santa Barbara, Calif.
ROVING VEHICLE MOTION CONTROL Final Report
B. P. Miller, T. M. Corry, D. E. Johnson, R. J. Johnston, and J. E. Lingerfelt Dec. 1967 200 p refs Prepared for JPL
(Contracts NAS7-100; JPL-951829)
(NASA-CR-92643; TR67-60) CFSTI: HC $3.00/MF $0.65 CSCL 22D

As the U.S. Space Program progresses toward the first manned landings on the moon, it is important to consider the directions into which future efforts should be channeled and the associated problems and requirements. Among the diverse possibilities are extended-area unmanned exploration of the moon and planets. For missions of this type, cogent reasons can be given for incorporating the ability to move about by including an instrumented roving vehicle on the landing spacecraft. The feasibility of doing so depends directly upon the ability to control the motions of the roving vehicle both safely and effectively from the earth. There have been previous studies of the problem of remote control of extra-terrestrial roving vehicles. These studies, which included

experiments with working models and laboratory studies of operator perception capabilities, were tailored mainly to the SLRV mission, i.e., survey and certification of Apollo landing sites on the moon. The present study is intended to treat the problem much more generally, by considering the whole range of possible system configurations and techniques applicable to both lunar and planetary roving vehicle motion control. Author

N68-15250# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
COMPARISON OF REUSABLE LAUNCH SYSTEMS WITH DIFFERENT TYPES OF PROPULSION [VERGLEICH WIEDERVERWENDBARER TRAEGERSYSTEME MIT VERSCHIEDENEN ANTRIEBSARTEN]
J. Lambrecht Bad Godesberg, W. Ger. Bundesmin. fuer Wiss. Forsch. Sep. 1967 81 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-19)

To reach equatorial orbits by launch from Europe requires a rotation of the orbital plane of at least 35°. Reusable launch systems can accomplish this only by either refueling an air-breathing first stage or the orbiting upper stage. The launch weights of 7 reusable launch systems for 3 tons of payload having various types for first stage propulsion do not differ considerably with one exception. The development and transportation costs of systems with air-breathing engines exceed those of rocket propelled systems by a factor of 2 or 3. The German contribution to an international development was indicated both with respect to funds and tasks. Author

N68-15304# Royal Aircraft Establishment, Farnborough (England).
THE FLIGHT OF THE SPACECRAFT VENUS 4, AND ITS DESCENT TO THE SURFACE OF THE PLANET VENUS [SOVETSKAYA MEZHPLANETNAYA STANTSIYA 'VENERA 4']
Nov. 1967 27 p Transl. into ENGLISH from Pravda (Moscow), Jun.–Oct. 1967
(RAE-TRANS-1264)

A detailed description is given of the Venus 4 spacecraft, launched on 12 June 1967, and of its flight to the planet Venus, which it reached on 18 October 1967. As it approached the planet a capsule separated from the spacecraft. This capsule survived the heating on re-entry and descended through the Venusian atmosphere by parachute for 94 minutes. Instruments aboard the capsule measured the composition of the atmosphere, mainly carbon dioxide; the temperature, which increased from 100°C at a height of 20 km to 280°C at the surface; and the pressure, which increased from about 2 atmospheres at a height of 20 km to about 20 atmospheres at the surface. Author

N68-15519# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
PAYLOADS AND THEIR EFFECTS ON SPACE FLIGHT SYSTEMS [NUTZLASTEN UND IHRE AUSWIRKUNGEN AUF RAUMFLUGSYSTEME]
J. Lambrecht and E. Schaefer Bad Godesberg, W. Germany Bundesmin. fuer Wiss. Forschung Jul. 1967 156 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-18) CFSTI: HC $3.00/MF $0.65

On the basis of studies on reusable launch systems for three tons of payload conducted during the last few years, the effect of payload type and density on the overall system was investigated, as well as the payload weight as a function of launch weights up to 1000 tons. The studies covered seven promising systems with different types of propulsion for the first stage and one or two rocket propelled upper stages. It was found that the effect of payload type and density down to a lower limit of 100 kg/m^3 is small on the overall system. Systems which do not utilize high velocity air breathing engines yield more economical solutions. Author

N68-15570*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
AUTOMATION IN SATURN 1 FIRST STAGE CHECKOUT
B. J. Funderburk Washington Jan. 1968 84 p refs
(NASA-TN-D-4328) CFSTI: HC $3.00/MF $0.65 CSCL 22D

The first section of the document describes the hardware and software systems that have been used for or in support of automatic vehicle checkout in the laboratory and at the Michoud assembly facility. The remaining sections summarize the test procedures and computer programs used in vehicle checkout and present some observations that have been made after a review of the automation effort. The document includes information on the checkout of the Saturn I Block I stages SA-1 through SA-4, Saturn I Block II stages SA-5 through SA-10, and the upgraded Saturn I stages SA-201 through SA-206. Author

N68-15667# European Space Research Lab., Noordwijk (Netherlands).
PRELIMINARY RESULTS OF THE FEBRUARY–MARCH 1966 ANDOYA CAMPAIGN
D. E. Page Paris ESRO Oct. 1967 20 p refs
(ESRO-SN-68) CFSTI: HC $3.00/MF $0.65

Six Centaure rockets, representing duplicate firings of three different payloads, were launched by ESRO from the Norwegian range at Andoya in February/March 1966, for the investigation of auroral phenomena. The first two pairs each carried three experiments and the last pair four. One launching was a failure owing to non-separation of the second stage of the rocket. The value of the scientific results in four of the other launchings was somewhat reduced because of the substandard performance of the rockets, apogees being 20–30 km lower than predicted. Brief details of the experiments are given and the preliminary results are described. Author (ESRO)

N68-15694# European Space Research Organization, Paris (France).
FEASIBILITY STUDY OF A COSMIC RAY SATELLITE
L. Scarsi (Milan Univ.), M. Sommer (Max-Planck-Inst., Garching), H. Marin (European Space Technol. Center), R. Pacault (European Space Technol. Center), J. Van Boeckel (European Space Res. Lab.) et al Aug. 1967 64 p refs
(ESRO-SP-23) CFSTI: HC $3.00/MF $0.65

An ESRO cosmic ray satellite project would become valuable if, in addition to a gamma-ray experiment, the electrons and heavy nuclei of the galactic cosmic radiation could be studied. Gamma-ray studies should cover both the radiation from extended regions (diffuse gamma radiation) and that from localized regions (discrete sources). From a consideration of the scientific objectives a highly-eccentric orbit may be chosen, or a low circular (Thor-Delta type satellite) orbit, the latter easing restrictions on weight and telemetry but introducing interference problems from the earth's shadow, albedo and trapped radiation. Both types of satellites are compared and found feasible from a technical point of view. The main problem areas are: sensors for the detection of the vertical in the low orbit satellite, number and size of solar paddles, capacity of the telemetry channel and non-rigid configuration of the highly eccentric orbit satellite. ESRO

N68-15850# Bolkow Entwicklungen K. G., Munich (West Germany).
DESIGN CRITERIA AND ALTERNATIVES FOR AN INTERPLANETARY SOLAR PROBE [ENTWURFSKRITERIEN UND -ALTERNATIVEN FUER EINE INTERPLANETARE SONNENSONDE]
Dietrich E. Koelle 1967 29 p In GERMAN DGRR-Symp. "Interplanetare Raumflugmissionen", Munich, 7 Dec. 1967
(DGRR-67-024; RF-87-O)

For the principally agreed joint US–German Project of an Interplanetary Solar Probe the main technical criteria are discussed as there are thermal problems, power supply, communications and attitude control modes. Further some spacecraft concepts and configurations are shown with three-axes-stabilization (ISOS I) and with spin-stabilization (ISOS II). These concepts are discussed and the relative advantages weighted. It is shown that a spinning vehicle for this mission with 0. 28 AE Perihelion has no major advantages over a three-axes-stabilized spacecraft regarding complexity, weight and cost. Otherwise the scientific value and the growth capability of a three-axes stabilized spacecraft is considered to be superior. Author

N68-15869# Junkers Flugzeug- und Motorenwerke A. G., Munich (West Germany).
LAUNCH SYSTEMS FOR SPACE VEHICLES [STARTVERFAHREN FUER RAUMFLUGSYSTEME]
E. Schaefer Bad Godesberg, W. Germany Bundesmin. fuer Wiss. Forschung Jul. 1967 52 p refs In GERMAN; ENGLISH summary
(BMWF-FB-W-67-16) CFSTI: HC $3.00/MF $0.65

An investigation of vertical and horizontal launches for reusable launch systems was conducted utilizing a point and time method of comparison. Evaluation of all important aspects, such as launch preparations, launch trajectories, loads etc. leads to the conclusion that the horizontal launch of reusable launch systems meeting European requirements (payload approx. 3 tons) is of definite advantage compared with the vertical launch direction. For this reason, various horizontal launch methods (unassisted launch, catapult assisted launch and launch by carrier plane) were studied in more detail. The launch catapult makes it possible to eliminate a landing gear designed to withstand a launch weight and at the same time reduces the propulsion requirement of the flying vehicle. The most important factor for comparing various catapult propulsion systems is its reliability; the hot water rocket has many advantages in this respect. The carrier plane enables the launch of reusable launch systems from typical airports and results in transport costs similar to a catapult launch. Author

N68-16009*# National Aeronautics and Space Administration, Washington, D. C.
LUNAR ORBITER
[1967] 12 p
(NASA Facts, V. 4, No. 4) GPO: $0.15; CFSTI: MF $0.65 CSCL 22B

Photographic capabilities of the Lunar Orbiter spacecraft are discussed, and sample photographs are included. Transferring orbiter photographs to earth is considered, and the picture signals picked up and their processing on earth is described. Attention is also given to spacecraft design. M.W.R.

N68-16015*# National Aeronautics and Space Administration, Washington, D. C.
SPACE APPLICATIONS 1966
Robert H. Mc Quain 1967 97 p refs
(NASA-SP-156) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Achievements during 1966 are summarized for the areas of application technology satellites, communications satellites, satellite geodesy, space technology applications to meteorology, and the navigation and traffic control satellite program. Space technology applications common to earth-oriented activities are reviewed, including COMSAT activities, weather satellites for the Environmental Science Services Administration (ESSA), and Nimbus II global data on the atmospheric structure. Mention is made of GEOS-I and PAGEOS, which contributed data to establish a worldwide geometric reference system and to define the earth's gravity field. M.W.R.

N68-16083# Hughes Aircraft Co., Culver City, Calif. Power Systems Dept.
HUGHES-DEVELOPED SOURCE ELECTRICAL POWER SYSTEMS. SURVEYOR. SYNCOM. INTELSAT 1 (HS303 EARLY BIRD). INTELSAT 2 (HS303A LANI BIRD). APPLICATION TECHNOLOGY SATELLITES
M. Swerdling Feb. 1967 141 p refs
(SSD-70049R)

Detailed descriptions are given of the electrical power subsystems employed on the following satellites: Surveyor, Syncom, Intelsat I (HS303 Early Bird), Intelsat II (HS303A Lani Bird), and Applications Technology Satellites. Emphasis is placed on system operation and predicted and actual flight performance, including radiation and environmental effects. Discussed are such areas as the solar panels, main batteries, auxiliary battery and auxiliary battery controls, regulators, weight analyses, and performance. C.T.C.

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N68-15037 Technische Hochschule Hannover (West Germany).
REPORT ON THE APPROXIMATE CALCULATION OF THIN, ISOTROPIC, ELASTIC PLATES USING MATRICES [BEITRAG ZUR NAEHERUNGSWEISEN BERECHNUNG DUENNER, ISOTROPER, ELASTISCHER SCHEIBEN MIT HILFE VON GITTERROSTELEMENTEN]
Bobo Dirr (Ph.D. Thesis) 1966 89 p refs In GERMAN

Transfer matrices are used to approximate elastodynamic properties of finite thin plates under load. A basic rectangular matrix solution for the bipotential equation of the plate is expanded to analyze frequencies and shapes of free oscillations, as well as the amplitudes of forced oscillations in the elastic plate. Transl. by G.G.

N68-15047# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
REPORT ON THE SAFETY FEATURE OF BOLTED JOINTS AT DYNAMIC LOAD [UNTERSUCHUNGEN UEBER DIE SICHERUNGSEIGEN-SCHAFTEN VON SCHRAUBENVERBINDUNGEN BEI DYNAMISCHER BELASTUNG]
Ernst-Guenter Poland (Ph.D. Thesis) 30 Jun. 1966 121 p refs In GERMAN

The loosening of screwed nuts and threaded bolts was analyzed for its dynamic causes and required methods to improve performance. Theoretical and experimental evaluations of load distribution, vibration effect, static pull, and required tension force

showed that extreme dynamic loads released the self-braking effect in the screw coupling. This resulted in decreased friction moments at the contacting surface of the nut and thus initiated the loosening process. Mechanical devices between nuts and bolts or above the nut provided additional safety mechanisms. Transl. by G.G.

N68-15144 Catholic Univ. of America, Washington, D. C.
AN EXPERIMENTAL VERIFICATION OF LIMIT ANALYSIS OF SHORT CYLINDRICAL SHELLS
Nicholas Perrone Oct. 1967 9 p refs
(Grant NSF GK-782)
(Rept.-4)

An experiment is discussed in which the dominant collapse mechanism of the circular cylindrical shell is associated with plastic flow between adjacent tangent points of the outer shell to the two consecutive toroidal tubes. Observations showed that a series of hinge circles developed giving rise to the corrugated deformation pattern. These axial wrinkles are attributed to the large radial shell deformations associated with plastic collapse. A mathematical model for analyzing shell collapse is depicted; this consists of a typical section of the shell subject only to transverse uniform pressure and no axial pressure. Possible differences between the mathematical model and the physical situation are assessed, and it is concluded that the experiment substantially verified a limit analysis of short cylindrical shells in which bending predominates. M.G.J.

N68-15145# Aerospace Corp., El Segundo, Calif. Technical Operations.
NONLINEAR THEORY OF BENDING AND BUCKLING OF LOVE–KIRCHHOFF PLATES AND SHELLS
Paul Seide Nov. 1967 99 p refs
(Contract F04695-67-C-0158)
(TR-0158(3305)-3; SAMSO-TR-67-86; AD-662578)

A general nonlinear theory of shells is derived from three-dimensional nonlinear elasticity theory and used to obtain exact linear perturbation equations for the determination of bifurcation points. These are specialized (1) to flat plates under inplane loading which preserves their flatness prior to buckling and (2) to shells of revolution which deform axisymmetrically under axisymmetric loading. The Love-Kirchhoff hypotheses for plates and shells are used. For the flat plate the strain-energy function is otherwise arbitrary, while for the shell of revolution the material must be either transversely isotropic or with axes of orthotropy coinciding with the shell generators and parallels. The specific example of a simply supported flat plate under uniform longitudinal compression, with the strain-energy function chosen as similar to that for small deformations of isotropic flat plates, is solved. Corrections to the classical theory are found to be of the same order of magnitude as those caused by shearing strains in planes normal to the middle surface. Author (TAB)

N68-15178# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
VIBRATIONS AND STABILITY OF A CONICAL TRIPLE LAYERED SHELL WITH FLUID FLOW IN THE MIDDLE LAYER [KOLEBANIYA I USTOYCHIVOST' KONICHESKOY TREKHSLOYNOY OBOLOCHKI S PROTEKAYUSHCHEY ZHIDKOST'YU V SREDIYEM SLOYE]
V. V. Stepanyuk and D. V. Babich 3 Aug. 1967 13 p refs Transl. into ENGLISH from Issled. po Prikl. Gidrodinamike (Kiev), 1965 p 15–19
(FTD-HT-23-554-67; AD-662199)

The vibrations and stability of a composite triple-layered conical shell were investigated. The shell consisted of two isotropic coaxial smooth layers rigidly joined at contact points formed by a corrugated middle layer. An ideal incompressible fluid of density rho sub 0 was flowing in the channels formed by the corrugation crimps and the external shells. The general rate of flow in the middle layer was constant. The analysis employs a coordinate system based upon the median surface of the middle layer. It was concluded that: (1) the frequency of shell vibration decreases continuously with increasing rate of flow; (2) the shell loses stability through divergence at supercritical rates of flow; (3) the amplitude of vibration increases or decreases depending on the direction of flow. TAB

N68-15212# Technische Hochschule Hannover (West Germany). Fakultaet fuer Maschinenwesen.
CONTRIBUTION ON THE CALCULATION OF VERY THIN, ISOTROPIC, ELASTIC PLATES AFTER THE GRATE PROCESS [BEITRAG ZUR BERECHNUNG DUENNER, ISOTROPER, ELASTISCHER PLATTEN NACH DEM GITTERROSTVERFAHREN]
Heinz Waller (Ph.D. Thesis) 21 Dec. 1966 104 p refs In GERMAN

A matrix method for static calculations on thin plates is compared with a numerical method that uses differential plate equations and their lines of intersection. The matrix solution is built with rectangular elements; it converges with increased element subdivisions against the differential analysis solution for the plate. It is shown that the precision of the matrix solution increases with the number of used matrix elements if their intersecting points are distributed evenly over the whole plate. Transl. by G.G.

N68-15221# Institut Franco-Allemand de Recherches, St. Louis (France).
TEST REPORT ON THE BEHAVIOR OF TWO REINFORCED CONCRETE SLABS IN A WIND TUNNEL [COMPTE RENDU D'ESSAIS DE TENUE AU SOUFFLE DE DEUX DALLES EN BETON ARME]
C. Thery, G. Gerspacher, C. Johe, and G. Mosser 28 Dec. 1966 36 p In FRENCH
(ISL-T-42/66)

High-density steel concrete plates of 1:3 armament ratio, side fusion, and strong anchor ties were exposed to shock wave pressures of 30 bar. Damage results were compared to those obtained on lighter concrete plates with a heavier steel armament ratio. It was found that damage was much smaller in the high density steel concrete plates. Author

N68-15224# Institut Franco-Allemand de Recherches, St. Louis (France).
EXTENSION OF A SHOCK ALONG AN ELASTIC WALL [AUSBREITUNG EINES DRUCKSTOSSES ENTLANG EINER ELASTISCHEN WAND]
H. D. Gruschka 12 Jan. 1967 34 p refs In FRENCH
(ISL-T-4/67)

Pressure shock wave propagation along an elastic wall is analyzed by forming the pressure functions for the δ-impulse and the unit step. It is shown that a critical shock propagation velocity exists that depends on flexural wave velocity. This critical velocity ratio is between the values of 0.6 and 1; below and above this ratio, propagation velocity decreases. Author

N68-15234# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
FURTHER RESEARCH ON THE EFFECT OF TEST MACHINE EXTENSIONAL RIGIDITY ON THE INITIAL BUCKLING LOAD OF UNREINFORCED CIRCULAR CYLINDRICAL SHELLS IN AXIAL COMPRESSION

Stanley C. Bailey and Wilfred H. Horton Dec. 1967 68 p refs
(Contracts DA-44-177-AMC-115(T); AF 49(638)-1495)
(SUDAAR 298; AFOSR-67-1588; AD-662348)

The inadequacy of classical small displacement theory of thin shells in explaining buckling phenomenon for circular cylindrical shells has long been established. Likewise, it is general belief that an explanation of their behaviour can be given by means of non-linear large deflection theory. The current interpretations of such theories when applied to these problems lean heavily upon the arbitrarily chosen energy criterion first given by Tsien, and predict that the initial buckling load of thin shells should be influenced by the testing machine stiffness. Two experiments described, statistically analyzed and discussed by the authors in a previous paper revealed that test machine extensional rigidity does not, to a high degree of probability, influence the initial failing load of axially compressed cylinders. These results were obtained from repeated tests on a single near-perfect aluminum specimen and individual tests on many less perfect steel shells. They had R/t ratios of 313 and 226 respectively and buckled at 77 and 45 percent of the classical critical load. Two additional experiments using the single special approach described in detail in this report supplement and extend the authors previous research by considering circular cylinders with higher R/t ratios which buckled at a lower percentage of the classical critical load. The results provide overwhelming evidence that the Tsien criterion is inapplicable in all problems considered. The consequence, however, is the same; a new look at the large displacement analysis and the appropriate criterion is needed. Author (TAB)

N68-15239*# Data Dynamics, Inc., Los Angeles, Calif.
INFLATABLE STRUCTURES IN SPACE
A. Kozorezov and A. Glukharev [1967] 6 p Transl. into ENGLISH from Aviats. i Kosmonavt. (Moscow), no. 10, 1966 p 71–73 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92596) CFSTI: HC $3.00/MF $0.65 CSCL 22B

Material composition, weight, size, and method of unfolding of inflatable structures for manned and unmanned space stations are reviewed. The design of a particular inflatable space station/laboratory for a prolonged flight in orbit with a crew of astronauts on board is described. A simpler inflatable spacecraft is also described. Other types of structures currently being developed (such as wire meshes, inflatable wing-parachutes) are also commented upon. L.S.

N68-15245*# Texas A&M Univ., College Station. Space Technology Div.
NONLINEAR ANALYSIS OF SHELLS OF REVOLUTION
James A. Stricklin 25 Jan. 1968 22 p refs
(Grant NGR-44-001-044)
(NASA-CR-92642; Rept.-68-51) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This report presents a summary of the research accomplishments and a description of the work in progress. The development of a computer code for the analysis of shells of revolution with symmetrical stiffness properties is 95% complete. A computer code for the linear analysis of shells of revolution with asymmetrical stiffness properties is complete and the computer code for the nonlinear analysis is 75% complete. Results from the computer codes have been compared with experimental and other theoretical results. Excellent agreement was obtained. All research efforts are on or ahead of schedule. Author

N68-15265# Entwicklungsring Nord, Bremen (West Germany). Abteilung Strukturmechanik.
THE NATURAL-MODES OF VIBRATION OF A SIMPLY SUPPORTED AND UNIFORMLY PRE-STRESSED ORTHOTROPIC CIRCULAR CYLINDRICAL SHELL [DIE EIGENSCHWINGUNGEN DER BEIDSEITIG GELENKIG GELAGERTEN ORTHOTROPEN ZYLINDERSCHALE UNTER GLEICHMAESSIGER VORSPANNUNG]
H. Oery and E. Hornung Bad Godesburg, W. Ger. Bundesmin. Fuer Wiss. Forsch. Jun. 1967 31 p refs In GERMAN; ENGLISH summary
(BMwF-FB-W-67-11)

Derivation of an approximate formula for computation of natural frequencies of an orthotropic cylindrical shell will be mentioned here. In this formula, the square of the natural frequency is given by an addition of three parts, namely: membran, bending and pre-stressing terms. This derivation follows from a simplified mathematical model. For isotropic shells as a special case, the formula has been compared with the published results. A numerical example for the above computations will be shown. Author

N68-15282 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE STABILITY OF FLOW OF A VISCOPLASTIC MEDIUM BETWEEN PLANES WITH A SLOT [OB USTOYCHIVOSTI TECHNIYA VYAZKO-PLASTICHESKOY SREDY MEZHOU PLOSKOSTYAMI SO SHCHEL'YU]
G. P. Prikazchikov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 11 Apr. 1967 p 60–64 refs (See N68-15278 06-10)

In extrusion of metals from a crack, with a certain ratio of the thickness of the working layer to the width of the crack, there occurs a loosening of the metal from the upper die and a further formation of a funnel. This effect can also be observed in materials other than metals. This seems to indicate that the loosening of the material depends on the geometry of the stamp (the ratio of the thickness of the layer to the thickness of the crack). The author assumes the length of the crack to be infinite in order to consider metal flow to be planar. He uses the method of hydrodynamic approximations and obtains formulas to solve the problem of distribution of stresses and particle velocities in the entire area occupied by the metal. Author

N68-15289*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A CRITERION FOR SELECTING REALISTIC NATURAL MODES OF A STRUCTURE
W. C. Hurty 1 Nov. 1967 28 p refs
(Contract NAS7-100)
(NASA-CR-92509; JPL-TM-33-364) CFSTI: HC $3.00/MF $0.65 CSCL 20K

This document reports the development of a criterion to be used in determining the natural modes and frequencies of vibration of a structure by analysis of a suitable conceptual or mathematical model. Analyses of complex structures by the method of component mode syntheses typically yield results that are accurate in the lower modes and inaccurate in the higher modes. The equation developed in this report yields a criterion that indicates which modes are accurate, or representative of the real structure, and which modes are inaccurate. This criterion is applied to the analysis of a real structural system. Author

N68-15291# Stanford Research Inst., Menlo Park, Calif. Poulter Lab. for High Pressure Research.
STRESS WAVE PROPAGATION IN A PRESTRESSED MEDIUM Final Report, Jun. 1, 1966–Jul. 31, 1967
Thomas J. Ahrens Oct. 1967 51 p refs
(Contract AF 19(628)-6048; ARPA Order 292; Proj. Vela-Uniform)
(SRI-PGU-6099; AFCRL-67-0529; AD-662894)

Explosion-induced radiation patterns in prestressed plates which represent two-dimensional models of explosions in the prestressed earth were studied. Radial explosive sources were detonated in plates of 1/8 in. thick glass and 1/8 in. and 1/16 in. Plexiglas prestressed in either tension or shear to various stress

levels (static principal stresses were on the order of 100 bars). Radiation patterns of the resulting plate compressional and plate shear waves were observed using dynamic photoelasticity (employing high speed photography) or using electrical strain gages (employing high speed, single-sweep oscillography). The measured compressional and shear velocities in Pyrex glass were 5.34 and 3.32 mm/microsec, and in Plexiglas they were 2.31 and 1.33 mm/microsec which agree closely with published data. Although compressional and shear waves were clearly optically resolved, no azimuthal variation was seen with compressional or shear wave radiation patterns (in spite of strong preferential cracking in the case of prestressed glass). This is because the photoelastic patterns resulted from superposition of a high static (approximately 100 bars) and relatively low dynamic (approximately 10 bars) stress. By contrast, radiation patterns recorded with the strain gages in Plexiglas indicated a sharp maximum in shear wave amplitude and possibly a slight maximum in compressional wave amplitude at approximately 30 degrees from the tensile axis. The ratio of the maximum longitudinal to maximum shear wave strain energy had a consistent minimum, (the ratio decreases by a factor of 10 to 100) at 30 degrees from the tensile axis. Author (TAB)

N68-15319*# National Aeronautics and Space Administration, Washington, D. C.

LINEAR THEORY OF SHELLS, PARTS 1 AND 2

K. F. Chernykh Feb. 1968 825 p refs Transl. into ENGLISH of the Publ. "Lineynaya Teoriya Obolochek" Leningrad, Leningr. Univ. Publ. House, Pt. 1, 1962; Pt. 2, 1964

(NASA-TT-F-11562) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The book gives a systematic presentation of the principles associated with the linear theory of thin shells. Solutions are presented for a whole series of problems encountered in practice. The book is designed for engineers and scientific workers who are concerned with the stress analysis of thin-walled structures. The book may also serve as a text for senior college students and for Fellows specializing in the theory of elasticity. Author

N68-15336# Brown Univ., Providence, R. I. Div. of Applied Mathematics.

SURFACE WAVE PROPAGATION FOR LINEAR VISCOELASTIC SOLIDS

Y. M. Tsai and H. Kolsky Sep. 1967 35 p refs

(Contract DA-31-124-ARO(D)-358)

(DA-358/7; TR-7; AROD-5606-3-E; AD-662760)

Experiments were carried out to observe the surface waves produced on large blocks of polyethylene and polymethylmethacrylate (p.m.m.) when specimens of these materials have been subjected to surface impacts of steel balls or when small lead azide charges have been detonated on the free surfaces. It was shown that if Poissons ratio is taken to be a real constant the shapes of surface waves can be calculated if the shape of the initial disturbance and the viscoelastic properties of the medium are known. It was shown that the complex nature of Poissons ratio results in only second order effects for the materials used. It was found possible to forecast the shape of surface waves produced by the impact of steel balls. The agreement with experimentally observed shapes was found to be excellent for the p.m.m. specimen. The theoretical predictions were less accurate for the polyethylene specimen, but the predictions here agreed reasonably well with the experiments. TAB

N68-15432# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

DISTRIBUTION OF PRESSURE ON SURFACE OF ELLIPSOIDS [RASPREDELENIYA DAVLENIYA PO POVERKHNOSTI ELLIPSOIDOV]

A. I. Shvets *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 55–61 refs (See N68-15426 06-19)

The results of an experimental investigation on supersonic flow past models of oblate ellipsoids in the range of Mach 1.48 to 3.02 and Reynolds numbers from 2.0 to 2.5×10^6 are presented. The pressure distribution over the surfaces of ellipsoids, and its space pattern at various angles of attack set by rotating the model around its axis, were determined. The flow field between the body and shock front and the position of the sonic point depending on the ratio of ellipsoid half-axes were considered. Comparison of the experimental results with theoretical calculations, using the Newton formula and other data, is presented in graphs. It is shown that the elongation of the ellipsoid as well as the increase in velocity lead to a decrease in the subsonic region and draw the sonic point nearer to a critical point. Author

N68-15433 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THEORY OF PLASTICITY OF ANISOTROPIC MEDIA [O TEORII PLASTICHNOSTI ANIZOTROPNYKH SRED]

V. A. Lomakin *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 63–69 refs (See N68-15426 06-19)

Stress–strain relations are proposed for work-hardening anisotropic media. The theory is based on Mises' yield condition for anisotropic media, the plastic potential hypothesis, and the work-hardening hypothesis according to which the work-hardening parameter is a function of the work of stresses over plastic deformations. In the isotropic case the proposed relations coincide with Reiss' theory. Author

N68-15436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

AN APPROXIMATE CALCULATION OF NONHOMOGENEOUS PLATES BY SUBDIVISION INTO ELEMENTS [PRIBLIZHENNYY RASCHET NEODNORODNYKH PLASTIN PUTEM RAZBIYENIYA NA ELEMENTY]

V. P. Kandidov *In its* Moscow. Univ. Herald. Ser. 1. Math., Mech. 27 Apr. 1967 p 87–95 refs (See N68-15426 06-19)

A general method of analyzing thin plates, by representing them as separate weightless homogeneous elements of rectangular and triangular form, is proposed. Special matrices whose elements are dependent on the geometrical proportions and elastic constants of elementary plates describe the elastic properties. The matrices are derived on the basis of the theory of thin plates with the deflection form of an elementary plate approximated by a power series. The method is valid for an approximate analysis of nonhomogeneous plates under both static and dynamic loads. Author

N68-15456*# National Aeronautics and Space Administration, Washington, D. C.

THEORY OF DEFORMABLE BODIES

E. Cosserat and F. Cosserat Feb. 1968 228 p refs Transl. into ENGLISH of the Publ. "Theorie des Corps Deformables" Paris, Librairie Sci. A A. Herman Fils, 1909 p 1–221

(NASA-TT-F-11561) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A historical introduction of the theory of elasticity is given and the concepts of the deformable line (one-dimensional elastic body), surface (two-dimensional elastic body), and medium (three-dimensional elastic body) are introduced. The equations of statics and dynamics of the deformable line, surface, and medium are derived in the same way: The kinematical relationships are established. A triad which moves with the body is introduced at each point of the body. Expressions for the variations of the rates of translation and rotation of the triad are introduced formulations for the deformed state. Euclidian action of deformation, external

force and moment, external stress, and moment of deformation are introduced, as well as transformation relationships for them. The equations are written in terms of various coordinates and using several formulations of the theory of elasticity. These are compared with equations obtained by Lagrange, Poincaré, Varignon, M. Duhem, Saint-Guilhem, and Poisson. The same quantities are introduced formulations for the deformed body in motion. The action formulations of Euclid, Euler, and others are discussed. The independent variables of Lagrange and Euler and the auxiliary quantities introduced are treated. The equations of the statics and dynamics of the deformable medium are derived in terms of Eulerian variables from those written in terms of Lagrange variables. The concepts of the calculus of variations are introduced. The action variable method expressed in terms of Euler and Lagrange variables is formulated. The concept of radiation energy of deformation and of motion is defined. Author

N68-15471# Aeronautical Research Council (Gt. Brit.).
A STUDY OF BINARY FLUTTER ROOTS USING A METHOD OF SYSTEM SYSTHESIS
G. T. S. Done (Edinburgh Univ.) 8 Aug. 1967 69 p refs
Sponsored by the Imp. Chem. Ind., Ltd.
(ARC-29342) CFSTI: HC$3.00/MF$0.65

The latent roots or eigenvalues of a binary aeroelastic system are studied using a method of system synthesis. In this, the generally damped system is considered to be built up from the equivalent undamped system, a special configuration of applied damping (called 'balanced' damping), and the remainder of the applied damping. It is also considered that all fundamental instabilities are basic to the undamped system. This system and the one with balanced damping are seen to possess very similar properties. The effect of changing the applied damping to its final general form is studied, and as a result, explanations of various flutter phenomena are found. Particular examples concern the appearance or disappearance of a pair of flutter speeds when damping is introduced, the crossing of modal frequencies as airspeed changes, and the severity of flutter onset. Author (ESRO)

N68-15478*# Boeing Co., Renton, Wash.
FATIGUE-CRACK PROPAGATION AND FRACTURE-TOUGHNESS CHARACTERISTICS OF 7079 ALUMINUM-ALLOY SHEETS AND PLATES IN THREE AGED CONDITIONS
S. H. Smith, T. R. Porter, and W. D. Sump Washington NASA Feb. 1968 96 p refs
(Contract NAS1-6474)
(NASA-CR-996) CFSTI: HC$3.00/MF$0.65 CSCL 11F

Tensile property, fatigue crack propagation, and fracture toughness tests were conducted to determine the effects of aging temperature and time, material thickness, specimen width, and configuration and physical environments of dry air, liquid nitrogen (−65°F), and distilled water on these properties. Residual strength characteristics were determined with surface-flawed specimens; precracked Charpy impact toughness tests also were conducted. The results showed that 7079 peak-age material has a faster rate of fatigue crack growth and a lower fracture toughness and residual strength than underaged and overaged materials. Underaged material exhibited the greatest fracture toughness and essentially the same rate of fatigue crack growth as that of overaged material. A slower fatigue crack growth rate was found for a decrease in plate thickness, an increase in panel width, a dry-air environment compared to distilled water, and a −65°F temperature. High fracture toughness and residual strength values were found for a decrease in plate thickness, an increase in panel width, a longitudinal grain direction, and an increase from −65°F to room temperature. Author

N68-15497# Naval Ship Research and Development Center, Annapolis, Md. Marine Engineering Lab.
LOW-CYCLE FATIGUE BEHAVIOR OF A DOUBLE-BOX STRUCTURE
M. R. Gross Dec. 1967 16 p refs
(NSRDC-2568; AD-662677)

A double-box test was devised to compare the effects of internal and external cyclic pressurization on the low-cycle fatigue behavior of HY-80 steel. The outer box was fabricated from 2-inch-thick plate and the inner box from 1-inch-thick plate. Major conclusions reached from this and previous tests were (1) the fatigue life of an externally pressurized box is appreciably greater than that of an internally pressurized box and (2) the fatigue crack propagation rate of an internally pressurized box having a 1-inch wall thickness is more than five times higher than that of one having a 1-inch wall thickness. Author (TAB)

N68-15561*# Carnegie Inst. of Tech., Pittsburgh, Pa. Dept. of Mechanical Engineering.
ANALYSIS OF NOTCHES AND CRACKS: A NUMERICAL PROCEDURE FOR SOLVING THE EQUATIONS OF ELASTO-PLASTIC FLOW IN THREE INDEPENDENT VARIABLES
J. L. Swedlow Dec. 1967 52 p refs
(Grant NGR-39-002-023)
(NASA-CR-66552; SM-7) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Using a recently derived form of the equation for elasto-plastic flow, procedures are set up for the solution of initial- and boundary-value problems. Attention is directed specifically to the problem of a longitudinally stressed, axisymmetric notched rod. The problem is stated explicitly in terms of ellipsoidal coordinates, which seem most natural for the geometric character of the problem. The basic numerical procedures are outlined in some detail, and their application to the problem at hand is discussed. Means for managing and utilizing the output are considered although, at this writing, no actual data are in hand. The underlying feature of the whole procedure is to provide solutions to such problems in general, such that the solutions will be of consistently high accuracy. Author

N68-15563# Brown Univ., Providence, R. I. Engineering Div.
FINITE DEFLECTIONS OF A RIGID VISCOPLASTIC STRAIN HARDENING ANNULAR PLATE LOADED IMPULSIVELY
N. Jones Oct. 1967 34 p refs
(Contract ARPA SD-86; Grant NSF GP-4825)
(ARPA-E53; AD-662399)

A relatively simple analytical treatment of the behavior of a rigid-plastic annular plate subjected to an initial linear impulsive velocity profile is presented. The influence of finite-deflections has been included in addition to strain-hardening and strain-rate sensitivity of the plate material. It is shown, for deflections up to the order of twice the plate thickness, that strain-hardening is unimportant, strain-rate sensitivity has somewhat more effect, while membrane forces play a dominant role in reducing the permanent deflections. Author (TAB)

N68-15574# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
BOUNDS TO TORSIONAL FREQUENCIES OF NON-UNIFORM SHAFTS, AND APPLICATIONS TO MISSILES
Nathan Rubinstein, Vincent G. Sigillito, and James T. Stadter Oct. 1967 57 p refs
(Contract NOw-62-0604-c)
(TG-958; AD-663266)

Non-uniform shafts can be used as accurate models for the analysis of missile vibrations. Digital programs that can calculate the upper and lower bounds to the torsional vibrations of such free, non-uniform shafts and can accept input data in standard engineering units were developed. How the programs are used (i.e., input/output data packages), underlying theory and its application to the programs, a description of the programs themselves, and the subroutines of the programs are presented. FORTRAN listings for both upper and lower bounds, along with sample printouts of both, are included. Improvements over other existing programs, offered by these programs are that they: (1) give upper and lower bounds that bracket the true frequencies, (2) are computationally fast and accurate, (3) can handle a large number of non-uniformities, and (4) can be easily extended to handle shafts that have more complicated variations of stiffness and mass than those presented.
Author (TAB)

N68-15617# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THE PROBLEM ABOUT VIBRATIONS OF BEAM IN A LIQUID [K ZADACHE O KOLEBANIYAKH BALKI V ZHIDKOSTI]
P. Ye. Tovstik *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 195–203 refs (See N68-15601 06-23)

The little lateral vibration an elongated bar with free sharp ends in perfect incompressible fluid investigated. The differential equation which describes this vibration is received, and an error of strip-method is estimated, when frequency of free vibration is found.
Author

N68-15672# Adviesbureau der Genie, The Hague (Netherlands).
APPLICATION OF CORRELATION METHODS IN THE CALCULATION OF RANDOM STRUCTURAL VIBRATIONS [DE TOEPASSING VAN CORRELATIEREKENING BU DE BEREKENING VAN CONSTRUCTIES OP TRILLINGEN DIE EEN TOEVALLIG KARAKTER BEZITTEN]
R. W. Trense Aug. 1967 74 p In DUTCH
(TDCK-49420; Rept.-166)

The theoretical and practical applications of mathematical probability values, mean square values, variants, autocorrelation, covariants, and ergodic processes are outlined for random vibrations in mechanical systems. The role of Fourier integrals in spectral analysis is treated, and the use of spectral density and mean square spectral density in defining ideal and limited white noise is discussed.
Transl. by K.W.

N68-15677# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
ON THE APPROXIMATION THEORY OF SHELLS WITH AVERAGE THICKNESS [K PRIBLIZHENNOY TEORII OBOLOCHEK SREDNEY TOLSHCHINY]
O. Yu. Kalekin 16 Jun. 1967 18 p refs Transl. into ENGLISH from Prikl. Mekh. (Kiev), v. 1, no. 12, 1965 p 29–37
(FTD-HT-66-530; AD-662201)

An approximation theory of shells of rotation is proposed without recourse to the Kirchhoff-Lyav hypothesis. For the derivation of the theory there is used the half-turn method and the expansion of the unknown values into series of Legendres polynomials. There were obtained the relationships of Hookes approximation law and a resolving system of equations. There are given numerical examples for a cylindrical shell and there is given a comparison with the precise solution.
Author (TAB)

N68-15769*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ELASTOPLASTIC ANALYSIS OF CIRCULAR CYLINDRICAL INCLUSION IN UNIFORMLY STRESSED INFINITE HOMOGENEOUS MATRIX
Alexander Mendelson Washington Jan. 1968 24 p refs
(NASA-TN-D-4350) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Equations have been derived and a method has been presented for performing an elastoplastic analysis of a system consisting of a circular cylindrical inclusion in a homogeneous matrix uniformly stressed at infinity and in a condition of generalized plane strain. The material properties of the inclusion and the matrix, including their stress–strain curves are assumed to be arbitrary and independent of each other. Several examples, including the limiting cases of a hole and a rigid inclusion, are presented. It is shown that the constraints imposed by the rigid inclusion sharply reduce both the stress and strain concentration factors over those for the hole. The results for a system roughly approximating a graphite fiber in a resin matrix indicate that the fiber acts nearly as a rigid inclusion and that strain hardening properties of the matrix play only a minor role in determining the plastic strain concentration factor for the case of plane strain.
Author

N68-15770# Brown Univ., Providence, R. I. Div. of Engineering.
APPROXIMATE SOLUTIONS FOR IMPULSIVELY LOADED ELASTIC PLASTIC BEAMS
J. B. Martin and L. S.-S. Lee Sep. 1967 28 p refs
(Contract N189(181)-60723A(X))
(BU/DTMB/10; AD-662669)

A unified method of approximating the response of elastic, rigid-plastic and elastic, perfectly plastic beams subjected to impulsive loading is described. The method is based on the uniqueness proof for such problems. A simply supported beam subjected to a uniform impulse is given as an illustrative example.
Author (TAB)

N68-15771*# Minnesota Univ., Minneapolis.
ON SOME MIXED BOUNDARY VALUE PROBLEMS FOR SPHERICALLY ISOTROPIC ELASTIC MEDIA
S. R. Moghe Apr. 1967 19 p refs
(Grant NGR-24-005-070)
(NASA-CR-92555; TR-111) CFSTI: HC $3.00/MF $0.65 CSCL 20K

Some mixed boundary value problems for spherically isotropic elastic medium are discussed. General solutions to these problems are obtained in terms of infinite series. Mixed boundary values on the surface give rise to triple series equations. They are solved by reducing to a single Fredholm integral equation.
Author

N68-15796*# Scientific Translation Service, La Canada, Calif.
COMPUTATIONS OF ELASTIC TENSOMETRIC ELEMENTS
G. F. Malikov, A. L. Shneyderman, and A. M. Shulemovich Washington NASA Feb. 1968 182 p refs Transl. into ENGLISH of the book "Raschety Uprugikh Tenzometricheskikh Elementov" Moscow, Mashinostr., 1964
(Contract NASw-1496)
(NASA-TT-F-513) CFSTI: HC $3.00/MF $0.65 CSCL 20K

The calculations for present-day elastic tensometric elements, and present methods for utilizing them are presented. Along with calculations for strength and rigidity, the problems of determining the nonlinearity of certain elastic elements are examined. Great attention is devoted to the use of statistical methods for experimentally determining several parameters characterizing the meterological properties of elastic elements.
Author

N68-15797# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

ABOUT AN APPROXIMATE METHOD OF CALCULATING AXIALLY SYMMETRICAL OSCILLATIONS OF SHELLS OF ROTATION WITH LIQUID FILLING [O PRIBLIZHENNOM METODE RASCHETA OSESIMMETRICHNYKH KOLEBANIY OBOLOCHEK VRASHCHENIYA S ZHIDKIM ZAPOLNENIYEM]

F. N. Shklyarchuk 18 Aug. 1967 19 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Mekhan. (Moscow), no. 6, 1965 p 123–129
(FTD-HT-66-527; AD-662246)

The hydrodynamic pressure in a liquid filling a vessel is determined approximately, neglecting the wave motions on the free surface (plane-motion hypothesis). An equation is derived for the plane motion of a layer of a liquid in a vessel and its solution and a formula for determining the total (static and dynamic) pressure in the liquid are presented. These means are used to determine the lower frequencies and modes of axisymmetric vibrations of arbitrarily shaped nonshallow shells of revolution filled with liquid. The Ritz and successive-approximation methods are used in the investigation. The vibration of a cylindrical membrane-stressed shell with a rigid flat bottom, fixed along the lower face is analyzed and the results obtained are compared with the data of an exact investigation. Two sample analyses of the vibrational behavior of shells of revolution are given: (1) of a conical shell completely filled with liquid; the shell is fixed along the edge to resist tangential displacements, and the deformation caused by the hydrostatic pressure is taken as the first approximation; in the second and third approximations, a formula for determining the frequency is obtained; and (2) of a cylindrical liquid-filled shell with a spherical bottom, by analyzing the displacements of walls and of the bottom and using the equations of the potential strain energy of the shell and of the kinetic energy of the liquid-filled shell. Cylindrical shells with shallow bottoms are also discussed. The results obtained are compared with the data of exact solutions and experiments.
Author (TAB)

N68-15835* Utah Univ., Salt Lake City.

CUMULATIVE DAMAGE IN THE MECHANICS OF VISCOELASTIC FRACTURE

W. B. Jones, Jr., F. R. Wagner, and M. L. Williams [1967] 13 p refs
(Grant NGR-45-003-029)
(NASA-CR-92512) CFSTI: $3.00 CSCL 20K

The theory of fracture for linear viscoelastic bodies is expanded to include arbitrary loading functions, and kinetic energy of the body as it fractures. Specific results are shown for sinusoidal fatigue with preload, and bilinear strain rate loading. Qualitative predictions for crack initiation and propagation are given. Comparisons with traditional cmulative damage theories are made.
Author

N68-15946# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

THE STRESSED STATE OF A VISCOELASTIC NONUNIFORMLY HEATED CYLINDER WITH A STARSHAPED CAVITY [NAPRYAZHENNOYE SOSTOYANIYE VYAZKOUPRUGOGO NERAVNOMERNO NAGRETOGO TSILINDRA SO ZVEVDOOBRAZNOY POLOST'YU]

V. G. Savchenko 27 Jul. 1967 18 p refs Transl. into ENGLISH from Nauchn. Soveshch. Po Teplo. Napryazh. v Elementakh Konstrukt. Dokl. (Kiev), no. 6, 1966 p 137–146
(FTD-HT-23-591-67; AD-662820)

A theoretical solution is derived for determining the state of stress of a long solid cylinder with a star-shaped central cavity having an arbitrary number of rays. The stresses are caused by a plane stationary temperature field and by a uniformly distributed pressure on the internal and external surfaces. The cylinder material is assumed to be homogeneous and its mechanical characteristics only insignificantly dependent on temperature. Under these assumptions, a solution to the problem is obtained by the N. I. Muskhelishvili method using functions of a complex variable, and formulas are derived for calculating the final total stresses on the inner and outer surfaces of the cylinder.
TAB

N68-15983# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF MECHANICS OF CONTINUOUS MEDIA

Waclaw Olszak *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 4–11 refs (See N68-15982 06-34)

Research activities in the domains of elasticity theory and related sciences are briefly reported. The motion of discrete defects in a linear elastic medium was studied. Problems of large strain of nonlinear viscoelastic and elastic bodies with internal degrees of freedom and couple stresses were investigated. In the area of thermoelasticity, stresses with steady temperature fields and the influence of dynamic loads were emphasized. Theories were developed for wave propagation in a visoelastic body and propegation of an axially symmetric crack. Research was done on approximate solutions to problems with plates, shells, and panels. The dynamic stability of plates and the state of stress in thick spherical shells were also investigated.
N.E.N.

N68-15985# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF VIBRATIONS

Ignacy Malecki *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 18–36 refs (See N68-15982 06-34)

Research is reported on mechanical and acoustic vibrations of elastic media and systems, embracing both continuous and discontinuous media. Studies are briefly described in the following main areas of investigation: dynamics of constructions, wave propagation, and mechano-thermo-elasto-magnetic field phenomena connected with vibrations in continuous media; audio frequency acoustics connected with the Polish language; active and passive applications of ultrasonics; piezoelectric elements and subsystems; and nondestructive testing of materials under conditions of fatigue.
N.E.N.

N68-15991# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

DEPARTMENT OF MACHINES THEORY

Stefan Ziemba *In its* Sci. Activities of the Inst. of Basic Tech. Probl. of the Polish Acad. of Sci. in 1965 Aug. 1967 p 78–81 refs (See N68-15982 06-34)

Among the research briefly reported are the investigation of the motion of nonlinear mechanical systems with lumper parameters, and the application of nonlinear vibration studies to machines such as rotor machines and automobiles. It is also mentioned that dynamic investigations were made of constructional materials, friction and wear, and tooth gears.
N.E.N.

N68-16083# Wisconsin Univ., Madison. Mathematics Research Center.

ON CONDITIONS FOR THE EXISTENCE OF DECAYING SOLUTIONS OF THE END PROBLEMS OF CYLINDERS

George W. Swan Aug. 1967 55 p refs
(Contract DA-31-124-ARO(D)-462)
(MRC-TSR-762; AD-662708)

A Laplace transform method is applied to the problem of a semi-infinite homogeneous elastic circular cylinder which is

free from stress on the curved boundary but has some form of prescribed displacements and/or axially symmetric stresses on the plane face. The eigen-function expansion is constructed in a rigorous way and the conditions are derived which allow the stress function to exhibit a decaying form. Associated with this problem is the Principle of Saint-Venant and in the last section is presented a numerical value to the fundamental decay constant. Author (TAB)

N68-16093*# Midwest Applied Science Corp., Lafayette, Ind.
THE DEVELOPMENT OF COMPUTATIONAL TECHNIQUES FOR THE IDENTIFICATION OF LINEAR AND NONLINEAR MECHANICAL SYSTEMS SUBJECT TO RANDOM EXCITATION, PART 2 Final Report
F. Kozin and C. H. Kozin 1967 31 p
(Contract NAS5-10106)
(NASA-CR-91802) CFSTI: HC $3.00/MF $0.65 CSCL 20K

A mathematical technique based upon principles of random function analysis, involving the estimation of various order moments of the input and output processes, is described. The technique is useful in identifying linear and nonlinear mechanical systems subject to random excitation. Examples involving a stationary mean square continuous, non-white, random process are worked out for first and second (oscillator) order systems. Estimates were obtained. Results of parameter identification by digitally simulating each of the examples are presented. A computer program used to simulate a system of five (or less) first order differential equations and to compute the second order moments used for calculating the parameters of the above system examples, is briefly described. L.S.

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N68-15042 Technische Hochschule Stuttgart (West Germany). Institut fuer Kernenergetik.
REVIEW OF THE RADIATOR DESIGN COMPLETED AT THE INSTITUTE FOR NUCLEAR ENERGY [UEBERSICHT UEBER DIE AM INSTITUT FUER KERNENERGETIK DURCHGEFUEHRTEN RADIATORENTWUERFE]
M. Groll and Th. W. Weisser Jul. 1967 51 p refs In GERMAN
(Rept.-5-39)

Two flat and two curved radiator designs for the thermoelectric power sources of spacecraft are described. The radiative energy capacity of the radiators varies, ranging from 70 kW to 1000 kW. The range of the mean radiative temperature is from 623° K to 900° K. Structural features, design and performance data, and illustrations are presented. Discussed are also efficiency and mass factors of electromagnetic pumps, radiator reliability, shielding, and meteorite protection. Transl. by K.W.

N68-15044# Technische Hochschule Hannover (West Germany).
COMBUSTION AND MIXING PROCESSES IN TURBULENT DIFFUSION FLAMES [VERBRENNUNGS- UND MISCHUNGSVORGAENGE IN TURBULENTEN DIFFUSIONSFLAMMEN]
Manfred Luebben (Ph.D. Thesis) [1966] 84 p refs In GERMAN

The turbulent diffusion flame of a propane jet between two parallel air jets in a combustion chamber was studied by observing jet mixing with and without combustion process. Static pressures and overall pressures at various jet ejection velocities, localized gas trace concentrations in the combustion chamber, and stability and lengths of the diffusion flame at various extinction points were evaluated. Results established that the air jets determined the combustion process in the chamber by carrying the propane with them towards the side walls of the chamber. The propane volume was the deciding factor for flame stability; observed flame lengths at differing extinction points were proportional to its numerical equivalence. Transl. by G.G.

N68-15119# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
CRITERIAL EQUATIONS OF NONSTEADY HEAT AND MASS TRANSFER IN MOIST MATERIALS [KRITERIAL'NYYE URAVNENIYA ENSTATSIONARNOGO TEPLO- I MASSOPERENOSA DLYA VLAZHNYKH TEL]
Yu. Mikhaylov 2 Aug. 1967 11 p refs Transl. into ENGLISH from Izv. Akad Nauk Latv. SSR, Ser. Energ. (Riga), no. 10, 1962 p 87–89
(FTD-HT-67-475; AD-662794)

The paper describes a mathematical treatment of nonsteady heat and mass transfer. TAB

N68-15243*# Techtran Corp., Glen Burnie, Md.
DETERMINATION OF THE THERMAL CONDUCTIVITY, THE SPECIFIC HEAT AND THE WEIGHT BY VOLUME (GROSS DENSITY) OF INSULATIONS FOR ROCKET TANKS FILLED WITH LIQUID HYDROGEN. PART 1: DESCRIPTION OF MEASUREMENT PROCEDURE [DIE BESTIMMUNG DER WAERMELEITFAEHIGKEIT DER SPEZIFISCHEN WAERME UND DES RAUMGEWICHTS (ROHDICHTE) VON ISOLATIONEN FUER MIT FLUESSIGEM WASSERSTOFF GEFUELLTE RAKETENTANKS]
B. Oglin and W. F. Zimni Washington NASA Jan. 1968 27 p refs Transl. into ENGLISH from ELDO/CECLES Rev. Tech. (France), v. 2, 1967 p 3–28
(Contract NASw-1695)
(NASA-TT-F-11148) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Experimental research into insulating foams at temperatures down to that of liquid hydrogen (20°K) is reported. In addition to a general study of the insulation of tank walls for cryogenic high-energy rocket states, a description is given of various measuring methods of determining the thermal conductivity, the specific heat and the density of insulating materials, together with a comprehensive review of the literature. Author

N68-15306# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
AN EXPERIMENTAL DETERMINATION OF THE HEAT TRANSFER RATES AT A CARET WING AT HYPERSONIC SPEEDS
R. A. East and D. J. G. Scott Nov. 1967 47 p refs
(AASU-273)

Measurements of the heat transfer rate to the lifting surface of a caret wing are reported. Experiments were performed in a hypersonic gun tunnel at Mach numbers of 8.4 and 9.7 and at Reynolds numbers (based on ridge line chord) of up to 3.8×10^6. Laminar, transitional and fully turbulent regimes have been studied. Comparison of the experiments with two-dimensional strip theory for the boundary layer shows that the predicted heat transfer rate is considerably in excess of the measured values for wing incidences above the design value. Better agreement was observed at design conditions. Observations of the transition position have indicated transition Reynolds numbers for the lifting surface of the caret wing consistently lower than those reported for unswept surfaces at similar conditions. Author

N68-15330*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EXPERIMENTAL INVESTIGATION OF NUCLEATE BOILING BUBBLE DYNAMICS IN NORMAL AND ZERO GRAVITIES
Thomas H. Cochran, John C. Aydelott, and Charles M. Spuckler Washington Feb. 1968 23 p refs
(NASA-TN-D-4301) CFSTI: HC$3.00/MF$0.65 CSCL 20M

The effects of gravity on the dynamics of bubbles generated on a flat horizontal surface are investigated in the heat-flux range defined as the discrete bubble region over a range of subcoolings, fluid properties, and heat-transfer rates. The zero-gravity data were obtained by allowing the experiment package to free fall in a 2.2-second drop tower, which permitted the attainment of less than 10^{-5} times Earth gravity. Data taken from high-speed motion pictures indicated that boiling was independent of gravity at high subcooling and that the transition from the discrete bubble region occurred at a lower heat flux in zero gravity than in normal gravity. Application of an analysis to the data indicated that a newly defined pressure force was of importance in bringing about bubble separation. Author

N68-15375 United Kingdom Atomic Energy Authority, Harwell (England). Research Group.
HIGH TEMPERATURE VAPORIZATION STUDIES BY MASS SPECTROMETRY 3: CALCULATIONS AND COMPUTER PROGRAMMES
J. Cuthbert and C. Silk Oct. 1967 27 p refs
(AERE-R-5424)

Starting from the primary output data from the mass spectrometer, the necessary calculations are described for obtaining pressures in the Knudsen cell. A total weight loss calibration of the mass spectrometer is described, with methods for following the changing condensed phase stoichiometry in incongruent vaporizations. Statistical tests are given for justifying the combination of results of several experiments. Computer programs for all these calculations are described. Author

N68-15451# Israel Inst. of Tech., Haifa.
LAMINAR AND TRANSITIONAL HEAT TRANSFER IN THE TWO DIMENSIONAL SEPARATED FLOW BEHIND A SHARP PROTRUDING LEADING EDGE
J. Rom and A. Seginer Jul. 1967 67 p refs
(Contract F61052-67-C-0033)
(TAE-71; SR-2; AD-662357)

Heat transfer rates are measured in the separated flow region behind the two-dimensional sharp protruding leading edge step model (boundary layer thickness is zero at the separation point) in the high enthalpy laminar near subsonic and supersonic flow in the shock tube. The measurements are carried out in a shock Mach number range from 2.3 to 10, and a corresponding flow Mach number range from 0.5 to 2.62. The Reynolds number, which is based on the height of the leading edge above the flat plate where the heat transfer rates are measured, varies from 300 to 17,000, and the local Reynolds number on the plate varies from 700 to 290,000. The results are correlated in terms of the non dimensional parameters of Nusselt number as a function of the Mach and Reynolds numbers and stagnation to wall enthalpy ratio. The variations of local, average and maximum heat transfer rates are presented. Author (TAB)

N68-15486# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
TRANSPORT PROCESSES WHEN INJECTING A FUEL OXIDIZER MIXTURE INTO A REACTING BOUNDARY LAYER [PROTSESSY PERENOSA PRI PODACHE V REAGIRUYUSHIY POGRANICHNYY SLOY SMESI TOPLIVO-OKISLITEL']
A. L. Mosse and G. T. Sergeyev 17 Jul. 1967 17 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (Moscow), v. 10, no. 3, 1966 p 311–317
(FTD-HT-23-790-67; AD-662822)

An analysis was made of the transport processes occurring when a fuel-oxidizer mixture is injected through a porous plate into the boundary layer in an air stream. Since the mass velocity of the oxidizer is lower than that required for stoichiometric mixture formation, combustion cannot take place inside the plate. The additional required oxygen flows into the combustion zone from the air stream. The reaction zone was considered to be located at a position where the concentration is stoichiometric. The analysis yielded expressions correlating the location of the reaction front with the fuel/oxidizer ratio at the inlet to the porous plate and with the NU and RE numbers of the air stream. The location of the reaction front was found to be a function of the fuel oxidizer ratio, the injection rate, and the Schmidt number. The heat transfer coefficient decreased as the injection rate increased. TAB

N68-15534*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
FLOW FIELD COMPUTATIONS FOR BLUNT BODIES IN PLANETARY ENVIRONMENTS (EQUILIBRIUM) Final Report
C. J. Studerus, C. L. Kyriss, H. Rie, and C. V. Dohner 28 Aug. 1967 163 p refs
(Contracts NAS7-100; JPL-951647)
(NASA-CR-92521) CFSTI: HC$3.00/MF$0.65 CSCL 20M

This study presents the variation of shock layer state and motion variables, and the resulting variation of radiative and convective heat transfer, about two blunt bodies traveling hypersonically at zero angle of attack in an assumed Martian atmosphere whose composition (by volume) is 70% N_2 and 30% CO_2. The body configurations are a spherically-blunted 60-degree sphere-cone with spherically-rounded shoulders and a sphere-cap with sharp shoulders. The two free stream conditions for which calculations are made correspond to those encountered in a typical hyperbolic Martian entry trajectory at the point where maximum stagnation point convective and radiative heat transfer occur and to the flow conditions in a ballistic range facility which has been used to simulate the stagnation point heating environment expected for the hyperbolic entry condition. The computations of the shock layer flows were made on the basis of a separate non-radiating equilibrium inviscid flow field analysis, and an associated non-radiating equilibrium viscous boundary layer analysis, together with a calculation of radiation from this combined inviscid-viscous shock layer. The effect of self-absorption of the flow field is accounted for in the radiation calculations, and the effect of the radiation on the convective heating is evaluated. Author

N68-15611# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
LAMINAR BOUNDARY LAYER WITH CALCULATION OF RADIATION IN THE ABSENCE OF PRESSURE GRADIENT [LAMINARNYY POGRANICHNYY SLOY S UCHETOM IZLUCHENIYA PRI OTSUTSTVII GRADIENTA DAVLENIYA]
Z. S. Galanova *In its* Leningrad. Univ. Herald, Math., Mech. and Astronomy Ser. 5 Sep. 1967 p 119–132 refs (See N68-15801 06-23)

A laminar boundary layer under conditions of local thermodynamic equilibrium when pressure gradient equals zero was studied. Radiation and absorption of the medium were taken into account. The method of integral characteristics (independent of direction) is used together with approximate relations between these characteristics, to simplify the case. The problem is reduced from one of integro-differential equations to a series of partial differential equations of second order. A solution of the problem is given by expanding in a series with two small parameters. The effect of radiation on convective heat transmission is explained via a

successive approximation technique. For a fairly cool gas with low absorption coefficients where the flow due to radiation from heating of the layer is small, it is found that radiation and absorption from the medium have an insignificant effect on the temperature profile in the boundary layer. L.S.

N68-15621*# National Academy of Sciences–National Research Council, Washington, D. C. Div. of Chemistry and Chemical Technology.

GLOSSARY OF TERMS IN HIGH TEMPERATURE, THERMAL PROTECTION TECHNOLOGY

Robert G. Lyle Jan. 1968 22 p

(Contract NASr-182)

(NASA-CR-92590) CFSTI: HC$3.00/MF$0.65 CSCL 20M

This glossary presents terminology and definitions frequently used in the technology relating to thermal protection as employed in the extreme environments of aerospace vehicle systems. The definitions presented result from efforts to achieve clarity and conciseness, but with sufficient generality to enable progress toward standardization in nomenclature. The results may be considered as representing an average usage in Government and industrial laboratories active in the technology. Contributions from such groups were obtained by means of a series of ballots which provided for selection from among alternative definitions. Author

N68-15640# United Technology Center, Sunnyvale, Calif. Research and Advanced Technology Dept.

RESEARCH ON COMBUSTION OF SOLID PROPELLANTS Technical Report, 1 Jul. 1966–31 Aug. 1967

R. J. Muzzy 11 Oct. 1967 83 p refs

(Contract DA-04-200-AMC-968(X))

(UTC-2136-TSR2; AD-662726)

The report describes theoretical and experimental studies to evaluate the effects of surface reactions on the acoustic response function of composite solid propellants. The AP oxidizer crystals were coated and the results showed coatings of Kel F and Viton reduce the acoustic response, the reduction increasing with increasing coating level. The effect of binder and curing agent on the response function was also investigated. Studies were also made on the effect of pressure on a carboxy-terminated polybutdiene-ammonium perchlorate propellant. The results indicated that over a pressure range from 100 to 500 psia both the maximum value of the acoustic response function and the frequency at which it occurs increased with increasing pressure. On the theoretical side the predictions from the model agreed well with experiment. Progress was made on the nonlinear analysis also. Author (TAB)

N68-15703# Bureau of Mines, Pittsburgh, Pa. Explosives Research Center.

INVESTIGATION OF FLAME PROPAGATION CHARACTERISTICS IN LAYERED GAS MIXTURES

Israel Liebman, Henry E. Perlee, and John Corry Feb. 1968 38 p refs

(BM-RI-7078)

The Bureau of Mines conducted an investigation to determine those factors that are significant in affecting the velocity of flames propagating along the boundary separating gaseous fuel and air. In addition the aerodynamic motion of the gases in the vicinity of such interfacial flames was delineated. Parameters in the study included flammable zone thickness, flammable zone concentration of gradient, fuel type, and position of the flame relative to various environmental surfaces. Of all these factors, the flammable zone thickness and burning velocity of the stoichiometric mixture were found to have the most significant effect on the flame speed. Motion of the gases in the vicinity of the interfacial flames was examined by particle track and interferometric techniques. The relative velocity of the interfacial flame with respect to the unburned gas on the central streamline was found to equal the burning velocity of a stoichiometric homogeneous fuel–air mixture. In addition, it was observed that the composition of the lean fuel–air mixture at the boundary of the combustion zone appears to be less than that defined as the fuel's lower flammable limit. Author

N68-15742*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

TRANSIENT SOLIDIFICATION OF A FLOWING LIQUID ON A COLD PLATE INCLUDING HEAT CAPACITIES OF FROZEN LAYER AND PLATE

Robert Siegel and Joseph M. Savino Washington Feb. 1968 27 p refs Presented at the ASME Winter Ann. Meeting, Pittsburgh, 17 Nov. 1967 *Its* Paper No. 67-WA/HT-34

(NASA-TN-D-4353) CFSTI: HC$3.00/MF$0.65 CSCL 20M

An analysis is made of solidification within a flowing medium where a convective boundary condition is imposed on the moving interface of the solidifying layer. The configuration is one in which a frozen layer forms in a warm liquid as it is chilled while flowing over a plane wall that is convectively cooled on the opposite side. The analysis includes the heat capacities of both the wall and frozen layer. The solution for frozen layer thickness variation with time is given as a closed-form algebraic equation and in graphical form so that results can be readily evaluated for use in practical applications. Some illustrative examples are given for flowing water in contact with Inconel plates of various thicknesses to demonstrate the effect of the heat capacities and the liquid and cooland temperatures on the growth of the ice layer and the temperature distributions in the ice and wall. Author

N68-15757*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Cryogenic Stage Programs.

STUDY ON HIGH-PERFORMANCE INSULATION THERMAL DESIGN CRITERIA Quarterly Progress Report

R. M. Coston, J. J. Brogan, and J. H. Guill 15 Jan. 1967 70 p refs

(Contract NAS8-20353)

(NASA-CR-61456; LMSC-A852904; QPR-3) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The correlation of the Complete System Thermal Model (CSTM) computer program predictions with the 82.6-inch tank test data was completed. CSTM predictions ranged from 16 to 34 percent lower than test data depending on the interpretation of ullage gas superheat test data. This correlation is based on cryostat data of insulation specimens which indicated an effective thermal conductivity of 3.6×10^{-5} Btu/hr-ft°R. A parametric study conducted with the CSTM to determine the effect of insulation system thermal conductivity on the effectiveness of the 82.6-inch tank thermal protection system shows a correlation between the test data and predictions at conductivities ranging from 5.2×10^{-5} Btu/hr-ft°R to 8.6×10^{-5} Btu/hr-ft°R depending again on the value of ullage gas superheat chosen. Experimental data were obtained in the continuing investigation of heat transport occurring in and around multilayer insulation penetrations, and data are also presented on the insulation performance without penetration. Additionally, data are presented on the insulation response to the initial penetration configuration. Results show a significant change in the system performance. Author

N68-15786*# Lockheed Missiles and Space Co., Huntsville, Ala. Research and Engineering Center.

STUDY OF THERMOELECTRIC COOLING OF ELECTRONIC EQUIPMENT Final Report

Jan. 1967 30 p
(Contract NAS8-18026)
(NASA-CR-61455; LMSC/HREC-A783745) CFSTI: HC $3.00/MF $0.65 CSCL 20M

The objectives of this study were threefold: investigation and test of thermoelectric coolers; the utilization of these thermoelectric elements in the cooling and temperature stabilization of electronic components; and the generation of a thermoelectric design manual. All the objectives have been achieved. Several thermoelectric coolers were chosen from different producers based on their heat transfer capacities, temperature differentials, coefficients of performance and sizes. These units were carefully tested and the data obtained compared with the manufacturer's published data. These tests showed clear performance differences among the producers of the thermoelectric elements. In general the quality of the units as measured by the coefficient of performance varied directly with the cost of the unit. An electronic mockup device for cooling electronic components was designed, fabricated, and tested. This unit performed as expected. A temperature stabilization chamber and a switching-type temperature control circuit were developed, designed, fabricated, and tested for a 0° to 100°C ambient temperature environment. The temperature inside the chamber was held to within 1.0°C of the initial setting (50°C). Author

N68-15795*# National Aeronautics and Space Administration, Washington, D. C.
CALCULATION OF THE TEMPERATURE FIELDS IN A BLADE OF A HIGH TEMPERATURE GAS TURBINE DURING INTERNAL COOLING [RASCHET POLEI TEMPERATUR V LOPATKE VYSOKOTEMPERATURNOI GAZOVOI TURBINY PRI VNUTRENNEM OKHLAZHDENII]
L. M. Zysina-Molozhen and M. P. Polyak Jan. 1968 11 p refs Transl. into ENGLISH from the Publ. "Tepio- i Massoperenos" Minsk, Nauka i Tekhn. Press, v. 6, 1966 p 261–271
(NASA-TT-F-11183) CFSTI: HC $3.00/MF $0.65 CSCL 20M

Calculation of the temperature fields in a cross-section of a gas turbine blade with an internally flowing coolant are investigated. The problem consists of calculating the temperature fields within the body of a blade of arbitrary shape and with an arbitrary number of internal cooling channels during variation of the local heat-transfer coefficients along the blade contour. The results make possible an evaluation of the effectiveness of the cooling system in terms of the optimum distribution of the cooling channels. The solution is based on determining the temperature function which corresponds to a Laplace equation with certain boundary conditions. The calculation was performed on a digital computer, and the method of programming is described in detail. Author

N68-15833*# Dynamic Science Corp., Monrovia, Calif.
COMBUSTION INSTABILITY PREDICTION USING A NONLINEAR BIPROPELLANT VAPORIZATION MODEL
R. J. Hoffman, R. O. Wright, and B. P. Breen Washington NASA Jan. 1968 100 p refs
(Contract NAS7-442)
(NASA-CR-920) CFSTI: HC $3.00/MF $0.65 CSCL 20B

An extension of the Priem–Guentert nonlinear annular combustion instability model for liquid rocket engines is presented. additions to the model include: droplet drag effects, propellant spray distributions, and independent heat and mass addition due to a bipropellant system. The addition of droplet drag to the transport equations produces a new dimensionless term, the drag parameter. Computer results show that droplet drag can produce large attenuations in sensitivity to combustion instability. Drop sprays are treated by defining a spray distribution function for both the fuel and oxidizer spray entering an annulus. Results of a parametric study of the influence of mean drop size and of standard deviation are presented. The instability equations were modified to independently calculate mass and heat addition, and these modifications were included in the computer solution. Generally, the independent addition of mass to the flow produced trends similar to the simultaneous addition of heat and mass. For comparison, a complete engine stability map was generated using both the bipropellant model and the monopropellant model. Significant differences are apparent in the predicted sensitivity to instability. Author

N68-15843*# General Applied Science Labs., Inc., Westbury, N. Y.
THE EFFECT OF MIXING, RADIATION, AND FINITE RATE COMBUSTION UPON THE FLOW FIELD AND SURROUNDINGS OF THE EXHAUST PLUMES OF ROCKET ENGINES BURNING RP1 (KEROSENE) AND LIQUID OXYGEN
O. Fortune and R. Edelman Dec. 1967 93 p refs
(Contract NAS8-21047)
(NASA-CR-61494; GASL-TR-681) CFSTI: HC $3.00/MF $0.65 CSCL 21B

A free shear layer mixing analysis, a "quasi-global" finite rate oxidation model for hydrocarbon burning, and a carbon cloud radiation analysis are herein coupled in an attempt to describe the turbulent exhaust plume of a hydrocarbon–oxygen rocket engine. The free shear layer mixing analysis is based on the boundary layer equations. The development of the "quasi-global" chemistry model is presented and comparison is made with experiments. The radiation analysis employs the grey gas assumption, takes into account the affects of plume curvature, and includes the back radiation to the engine base. Author

N68-15872*# Miami Univ., Coral Gables, Fla. Dept. of Mechanical Engineering.
THERMAL CONDUCTANCE OF TWO DIMENSIONAL CONSTRICTIONS Interim Report
T. Nejat Veziroglu and Suresh Chandra Jan. 1968 34 p refs
(Grant NGR-10-007-010)
(NASA-CR-92574) CFSTI: HC $3.00/MF $0.65 CSCL 20M

A theoretical and experimental investigation of thermal conductance of two-dimensional constrictions has been carried out for both symmetrical and eccentric constrictions. Analytical solutions for both of these cases have been obtained. The solutions have been presented in terms of dimensionless numbers—a conductance number and a constriction number for the symmetrical case, and additionally an eccentricity number for the eccentric case. A series of experiments have been run by making use of the electrical analogy. Good agreement has been found between the theories and experiments. The results have also been compared with previously reported experiments and theories. Author

N68-15879# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
ON THE SOLUTION OF THREE-DIMENSIONAL HEAT-CONDUCTION PROBLEMS
V. I. Makhovikov 28 Sep. 1967 20 p refs Transl. into ENGLISH from Akad. Nauk SSSR, Izv., Energ. i Transp. (USSR) no. 3, 1966 p 109–116
(Contract NOw-62-0604-C)
(TG-230-T531; AD-663074)

A method is described and applied for solving a heat-conduction problem for a body of revolution of arbitrary shape under unsteady heat conditions, the temperature varying in time according to an exponential law, the initial conditions being neglectable. According to this method, the body is assumed to consist of an inhomogeneous anisotropic material; the density, specific heat and thermal-conductivity coefficients of the body are

such that effective methods of solving two-dimensional problems can be used and a solution to a heat-conduction problem for a body made of almost-homogeneous material can be obtained. TAB

N68-15942*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DISPLACEMENT OF DISINTEGRATING LIQUID JETS IN CROSS FLOW
Frederick P. Povinelli Washington Feb. 1968 21 p refs
(NASA-TN-D-4334) CFSTI: HC$3.00/MF$0.65 CSCL 21B

The displacement of three sizes of liquid jets breaking up in a crossflow was measured in a shock tube. Data were obtained for water, oxygen, n-heptane, and three glycerol–water mixtures in gas flows up to 1080 feet per second (329 m/sec). The displacement was approximately proportional to gas velocity squared and inversely proportional to jet diameter. Data were correlated with an empirical parameter. A simple model of jet displacement which includes the rate of mass removal also led to a correlation of the data. Author

N68-15958# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
THERMAL MOTION IN LINEAR POLYMERS AT LOW TEMPERATURES [TEPLOVOYE DVIZHENIYE V LINEYNYKH POLIMERAKH PRI NIZKIKH TEMPERATURAKH]
I. V. Sochava *In its* Leningrad. Univ. Herald. Phys. and Chem. Ser. 6 Sep. 1967 p 67–77 refs (See N68-15951 06-06)

From new and previously obtained data on the temperature dependence of the heat capacities of certain linear polymers at low temperatures it is shown that the linear nature of the dependence of C_p on T is not a result of the chain-like structure of the polymers, but rather that it is the result of superimposition of the heat capacities of the skeleton and the lateral groups. The temperature at which a close linear dependence of C_p on T is experimentally observable is high for skeletal oscillations, the heat capacity having practically the classical value. By comparing the heat capacities of specially selected objects the author obtained data on the decelerated rotation of lateral radicals. New experimental data on the C_p on T for polyvinylidene chloride were obtained. Author

N68-16036 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
RADIANT GAS FLOW NEAR THE STAGNATION POINT OF A BLUNT-NOSED BODY [TECHENIYE IZLUCHAYUSHCHEGO GAZA V OKRESTNOSTI KRITICHESKOY TOCHKI TUPONOSOGO TELA]
G. A. Kolton *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 121–128 refs (See N68-16026 06-23)

The Freeman–Cherny method is applied to determining viscous flow of a heat-conducting radiative gas near the stagnation point of a blunt-nosed body. Dissipation, density of radiative energy, radiation pressure, and the effect of radiation on the free stream flow parameters are neglected. The method consists in the solution of a single nonlinear integro-differential equation for the gas enthalpy. This equation is transformed to an integral equation, the solution of which is sought by successive approximations. Flow past a sphere is considered as an example. The method also makes it possible to determine the temperature distribution in a shock layer near the stagnation point. Author

N68-16046 Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
NONSTATIONARY MELTING OF BODIES UNDER THE ACTION OF AERODYNAMIC HEATING [NESTATSIONARNOYE OPLAVLENIYE TEL POD DEYSTVIYEM AERODINAMICHESKOGO NAGREVA]
S. K. Matveyev *In its* Leningrad. Univ. Herald. Math., Mech. and Astronomy Ser. 17 Apr. 1967 p 203–208 refs (See N68-16026 06-23)

A problem of unsteady aerodynamic melting of a body with formation of a liquid film on the surface is investigated. The motion of a film under the action of a pressure gradient and skin friction considered at times close to the onset of melting is of a laminar nature and is described by a system of equations equivalent to those of a boundary layer problem. Inertial terms in the momentum equation and skin friction heat transfer in the energy equation are neglected. Stagnation and thermodynamic temperatures are assumed to be approximately equal. A method using the Lagrange variables is outlined which makes the solution of the problem much easier at times close to the onset of the melting process. Author

N68-16049*# West Virginia Univ., Morgantown.
THERMAL CONTROL CHARACTERISTICS OF A DIFFUSE BLADED, SPECULAR BASE LOUVER SYSTEM Status Report, Jul.–Dec. 1967
H. W. Butler and E. A. Stipandic 21 Dec. 1967 13 p refs
(Grant NGR-49-001-014)
(NASA-CR-92591) CFSTI: HC$3.00/MF$0.65 CSCL 20M

Movable shutters or louvers are an active means used for spacecraft thermal control. A louver system consisting of diffuse, low-emissivity, movable, parallel blades and a specular, high-emissivity base is analyzed. The analysis considers the solar radiosity to be different for distinct basic areas on the diffuse blades. These basic areas are due to only partial solar impingement of the blades. From the analysis all applicable heat transfer characteristics are derived for all possible solar angles and blade opening angles. A comparison of the results of this analysis with that of the presently used specular blade diffuse base louver system shows that this new configuration has the capability of dissipating eight times as much heat as the present system in full sunlight for one particular blade and solar angle. The minimum blade temperature will be about 200°R less for the diffuse bladed system because of the elimination of the multiple specular reflections of the sun's energy by a specular blade. The results are presented graphically for a base temperature of 530°R(21°C). Author

34 GENERAL

Includes reports of a broad nature related to industrial applications and technology, and to basic research; defense aspects; law and related legal matters; and legislative hearings and documents.

N68-15068# National Aeronautics and Space Council, Washington, D. C.
REPORT TO THE CONGRESS FROM THE PRESIDENT OF THE UNITED STATES
1967 151 p

The accomplishments of the first decade of the space program are summarized, and details are presented on the various goals attained and the research progress achieved during 1967. The responsibilities of the National Aeronautics and Space Council are defined, and Department of Defense aeronautical and space activities are discussed. The joint AEC/NASA nuclear rocket program achievements are reported. The contribution of the State Department to the national space program and its efforts to foster international cooperation are chronicled, as is the support given by the National Science Foundation, the National Academy of Sciences, the Smithsonian Astrophysical Observatory, the United States Information Agency, and the Arms Control and Disarmament Agency.

The Commerce Department's participation is discussed in terms of the four major organizational components: the National Bureau of Standards, the Environmental Science Services Administration, and the Office of State Technical Services. The Transportation Department's role in sponsoring aeronautical research is recorded, and the regulatory activities of the Federal Communication Commission are discussed in relation to communications satellites. M.G.J.

N68-15094# RAND Corp., Santa Monica, Calif.
REFLECTIONS ON SATELLITES FOR EARTH RESOURCE SURVEYS: PERSONAL CONTRIBUTIONS TO A SUMMER STUDY
Amrom H. Katz Dec. 1967 36 p refs
(P-3753; AD-663371)

Contents: The case for aircraft in earth resource surveys: Discussion of a proposed aircraft system for earth resource surveys, or, how to meet all requirements with men in aircraft; A discussion of a hypothetical photo satellite system for land use survey; Facing the analysis problem: How to start; The limiting case. TAB

N68-15208# Harvard Univ., Cambridge, Mass. Dept. of City and Regional Planning.
THE GEOMETRY OF MIXED HEXAGONAL HIERARCHIES IN THE CONTEXT OF CENTRAL PLACE THEORY
C. Ernesto S. Lindgren 22 Dec. 1967 47 p refs
(Contract N00014-67-A-0298-0004)
(TR-7; AD-663296)

The paper suggests one geometric arrangement of mixed hexagonal central place hierarchies which encompass all the geometric arrangements obtained by mixing the three basic arrangement ratios (1:3, 1:4, 1:7) in any manner and/or at any hierarchical level, demonstrating the existence of that arrangement and its geometric generality. Author (TAB)

N68-15226# Swiss Association for Space Technology, Zurich (Switzerland).
BULLETIN NUMBER 4
10 Oct. 1967 21 p In FRENCH and GERMAN
CFSTI: HC $3.00/MF $0.65

This Bulletin reports mainly on the General Assembly Meeting in 1966 and contains conference papers on a) the national space research program which envisages projects of ultraviolet stellar photometry from balloons and ultimately rockets; mass spectroscopy from NASA and ESRO rockets and satellites; and mathematical methods for orbit calculation, evaluation of infrared data and optical orbit tracking, b) technical and legal solutions envisaged for a European space technology utilization office. Finally, a brief summary is given of the International Astronautic Federation's 18th congress, held in Sep. 1967 in Belgrade. ESRO

N68-15349 Advisory Group for Aerospace Research and Development, Paris (France).
INFORMATION BULLETIN
Nov. 1967 30 p
(AGARD-67/3)

Proceedings of the AGARD annual meeting held September 8 and 9, 1967, in Turin are summarized. Reference is made to the various speeches made at the meeting, and the address of Secretary General Manlio Brosio is included. M.W.R.

N68-15482*# Missouri Univ., Columbia. Research Center.
FEDERAL R&D EXPENDITURES AND THE GEOGRAPHIC DISTRIBUTION OF R&D ACTIVITY
John M. Brazzel and Gary K. Freerksen 19 Oct. 1967 12 p refs
(Grant NGR-26-004-012)
(NASA-CR-91657) CFSTI: HC $3.00/MF $0.65 CSCL 05C

Comparisons of state distributions of federal research and development funds and distributions of scientists engaged in R and D activities were made by using Gini coefficients to determine the extent of concentration or inequalities in these regional distributions. These coefficients indicate a fairly high degree of inequality in the distribution of scientists for the years 1962, 1964, and 1966; as well as an absence of any changes in the relative inequality of distribution during the 1962–1966 period. M.W.R.

N68-15494* California Univ., Los Angeles. Graduate School of Business Administration.
AN IDENTIFICATION AND ANALYSIS OF ORGANIZATIONAL BARRIERS TO INNOVATION
L. Glen Strasburg Nov. 1967 28 p
(Grant NGR-05-007-090)
(NASA-CR-91664; RP-23) CFSTI: $3.00 CSCL 05A

Barriers that might hinder creativity and innovation at a large governmental theoretical engineering laboratory were studied, and data from a second laboratory engaged in exact design and hardware development are being processed for a comparative analysis. Based on barriers reported by a representative sample of technical people, it is concluded that creativity and innovation are adversely affected because technical staff wants to be recognized for personal contribution and rewarded, particularly in terms of nonmonetary recognition. Further, they want to be stimulated at the working level, told what is going on, and have their ideas heard by management. M.W.R.

N68-15502*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center.
MANAGERIAL COST ACCOUNTING FOR A TECHNICAL INFORMATION CENTER
John G. Helmkamp Jan. 1968 308 p refs
(Contract NSR-15-003-055)
(NASA-CR-92640) CFSTI: HC $3.00/MF $0.65 CSCL 05A

A two-fold solution to the cost information deficiency problem is proposed. A formal managerial cost accounting system is designed expressly for the two information services of retrospective search and selective dissemination. The system was employed during a trial period to test its effectiveness in a technical information center. Once appropriate service cost data are available, the statistical cost model developed in this study can be used in lieu of the formal cost accounting system and will provide an efficient and economical cost control technique. A computerized data processing function is employed to convert cost data recorded during the production process on various source documents into relevant managerial cost information. A random sample of five searches is selected every month for both information services, and the direct costs consumed for each sampled search are registered on a single record. Author

N68-15538*# National Aeronautics and Space Administration, Washington, D. C.
EVOLUTION TOWARD A SPACE TREATY: AN HISTORICAL ANALYSIS
John Michael Kemp (George Washington Univ.) Sep. 1966 225 p refs
(NASA-TM-X-60833; HHN-64) CFSTI: HC $3.00/MF $0.65 CSCL 05D

An historical discussion is presented on space treaty development, including the precedent for a spatial treaty and efforts toward promoting peaceful uses of outer space and disarmament. Political stimulation and international cooperation are described, and United Nations resolutions are covered. The Antarctic treaty and

the analogy of the space treaty to it are discussed. United Nations resolutions and reports; the Antarctic and the nuclear weapon test ban treaties; and the U.S. and U.S.S.R. drafts of the space treaty are appended. N.E.N.

N68-15564*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RESEARCH SUMMARY NO. 36-9, VOLUME 1 FOR THE PERIOD APRIL 1, 1961 TO JUNE 1, 1961
1 Jul. 1961 104 p refs
(Contract NASw-6)
(NASA-CR-92558; JPL-RS-36-9, V. 1) CFSTI: HC $3.00/MF $0.65 CSCL 20

Continuing research activities are reported. The general fields of endeavor covered are the following: space instrumentation and systems analysis; guidance and control systems and components; telecommunications systems, elements, and related mathematics; basic research in chemistry, physics, and gas dynamics; materials research and plasma confinement; wind tunnel facilities; and liquid and solid propellant propulsion. N.E.N.

N68-15671# European Space Research Organization, Paris (France).
GENERAL REPORT 1966
[1967] 143 p
CFSTI: HC $3.00/MF $0.65

The main objects of the annual report are to describe the nature and scope of the work done during 1966, which was the last year of the Organization's first three-year period, to give an end-of-year progress report on current projects, to provide a summary of the results of experiments carried out and, lastly, to highlight the major policy decisions made. ESRO

N68-15755*# Missouri Univ., Columbia. Research Center.
REGIONAL EQUITY AND THE GEOGRAPHIC DISTRIBUTION OF FEDERAL R&D FUNDS
John M. Brazzel 8 Sep. 1967 36 p refs
(Grant NGR-26-004-012)
(NASA-CR-91656) CFSTI: HC $3.00/MF $0.65 CSCL 05C

Geographical patterns of federal research and development funds are discussed, and an analysis is presented of the relationships between state characteristics and the distribution of federal R and D funds as reported by the Daddario subcommittee. Various aspects of the problem of regional inequity in distribution of these funds are considered, including the spatial allocation of funds, the equitable treatment of regions, and regional effects of federal R and D funds. In 1965, 3 of 10 states received 37 and 65%, respectively, of federal R and D funds; and distribution was highly correlated with the scientific capabilities of the institutions. Rather than to reallocate the distribution of these funds, increasing the educational facilities and research capabilities are suggested. While an inequity in funds distribution is noted, it is also noted that R and D funds are a very small portion of the federal budget. M.W.R.

N68-15774*# Data Dynamics, Inc., Los Angeles, Calif.
THE BOUNDARIES OF SOVIET SCIENCE
1967 5 p Transl. into ENGLISH from Izv. (Moscow), 7 Feb. 1967 Prepared for JPL
(Contract NAS7-100)
(NASA-CR-92570) CFSTI: HC $3.00/MF $0.65 CSCL 05A

The opening speech of the February 1967 meeting of the Soviet Academy of Sciences is reviewed. The duty of the scientists to accelerate the utilization of scientific investigations in industry is emphasized. Some of the more important achievements during 1966 are mentioned. These include the soft landings on the moon by Luna 9 and Luna 13, the launching of a balloon-borne telescope, development of new high strength steels, improvements in optical quantum generators, and linear accelerator studies. Economic reforms and problems of the national economy are also briefly discussed. N.E.N.

N68-15817 Mitsubishi Heavy Industries, Ltd., Tokyo (Japan).
OPTIMAL CONTROL STUDY OF LINE BALANCING
Tadasu Wake and Saburo Nukui 1967 20 p refs In JAPANESE; ENGLISH summary
(MTB-010044)

Many analytical studies on various line-balancing problems have been reported. So far, line-balancing problems of "multiproject on one line" and "multiworker at one station" have not been studied. In this report, an algorithm for the above problem based on the method of Dynamic Programming and its computer program system named GLBS (General Line-Balancing System) is reported. Author

N68-15843# Aerospace Corp., El Segundo, Calif.
TECHNICAL DIRECTION AND EVALUATION OF COST ANALYSIS FOR SPACE SYSTEM STUDIES
Joseph A. Neiss and Herbert Brown (AFSC, Los Angeles, Calif.) May 1967 45 p refs
(Contract AF 04(695)-1001)
(TR-1001(2515-01)-2; SSD-TR-67-98; AD-662886)

Economic and cost effectiveness analyses of proposed system concepts have become vital requirements in virtually all U. S. Air Force Space Systems Division studies. Since development of a space system is extremely costly, lead time is lengthy, and budget limitations are severe, there is a clear need to forecast the total systems cost and effectiveness of a proposed new system as early in the planning cycle as possible. This report presents highlights of the significant aspects of technical direction efforts in systems cost and cost effectiveness analyses. Major objectives of this effort are to ensure that the industry contractor: (a) Performs a total system cost analysis of sufficient depth and validity to permit analysis and evaluation; (b) Identifies those operational design and hardware concepts which will provide the greatest savings in total systems cost; (c) Properly validates those significant concepts and cost relationships which will lead to the selection of an optimum configuration. Recommendations on the approach and techniques to fulfill these objectives are provided. The uses and limitations of industry cost models, cost estimating relationships, and other estimating methods are discussed. Common pit-falls in system cost analysis are illustrated to indicate the guidance necessary. TAB

N68-15863*# Stanford Univ., Calif.
CRITERIA FOR INVESTMENT SELECTION
Alan J. Seelenfreund 27 Oct. 1967 17 p refs Supported in part by NASA
(Contract Nonr-225(53))
(NASA-CR-92600; TR-100) CFSTI: HC $3.00/MF $0.65 CSCL 05C

A scarce resource is to be periodically allocated among several investment opportunities each of which produces a payout of the same resource in future periods. Future payouts may be reinvested, the object being to maximize some measure of accumulated wealth. The maximum internal rate of return criterion and the mathematical programming approach to this problem are analyzed and under certain stability conditions are shown to agree. Under these conditions the optimal prices in the dual program must initially lie near a discount vector derived from the maximum internal rate of return which is the systems von-Neumann price vector. In this sense the maximum internal rate of return may be

used as an interest rate to "price out" the opportunities available on the planning horizon even though no external rate of interest is assumed. Author

N68-15982# Polish Academy of Sciences, Warsaw. Inst. of Basic Technical Problems.

SCIENTIFIC ACTIVITIES OF THE INSTITUTE OF BASIC TECHNICAL PROBLEMS OF THE POLISH ACADEMY OF SCIENCES IN 1965

Aug. 1967 93 p refs

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1. DEPARTMENT OF MECHANICS OF CONTINUOUS MEDIA W. Olszak p 4–11 refs (See N68-15983 06-32)
2. DEPARTMENT OF FLUID MECHANICS W. L. Fiszdon p 12–17 refs (See N68-15984 06-12)
3. DEPARTMENT OF VIBRATIONS I. Malecki p 18–36 refs (See N68-15985 06-32)
4. DEPARTMENT OF ELECTRONICS W. Rosinski p 37–58 refs (See N68-15986 06-26)
5. DEPARTMENT OF THEORY OF THE ELECTROMAGNETIC FIELD K. Bochenek p 59–61 refs (See N68-15987 06-25)
6. DEPARTMENT OF METALS A. Krupkowski p 62–67 refs (See N68-15988 06-17)
7. DEPARTMENT OF MAGNETICS A. Smolinski p 68–75 refs (See N68-15989 06-26)
8. DEPARTMENT OF ENERGY TRANSFORMATIONS Z. Jung p 76–77 refs (See N68-15990 06-03)
9. DEPARTMENT OF MACHINES THEORY S. Ziemba p 78–81 refs (See N68-15991 06-32)

N68-15996*# Indiana Univ. Foundation, Bloomington. Aerospace Research Applications Center.

AN EXPLORATORY STUDY OF INDIVIDUAL INFORMATION-PROCESSING AND DECISION-MAKING

Final Report

David W. Cravens (Ph.D. Thesis) 15 Aug. 1967 213 p refs

(Contract NSR-15-003-055)

(NASA-CR-92584) CFSTI: HC $3.00/MF $0.65 CSCL 05I

The overall objective of the study is an exploratory investigation of the possible correlates of individual information processing which takes place in solving technical tasks associated with research and development projects and programs. More specifically, the effort is intended to seek out the apparently important variables relating to information processing, the individual, and the task within a given environment; link these variables into a conceptual analytical structure; and then investigate the existence of relationships among the variables via a field study. The study consists of four interrelated phases. The first concerns the identification and evaluation of applicable research foundations. The second phase involves the development of a conceptual system of variables for use in identifying potential relationships and investigating them empirically. The third phase deals with the specific methodology utilized in the study. The final phase concerns the analysis of the empirical data of the study utilizing canonical analysis. The conceptual system of variables appears to be highly associated, with certain variables playing more important roles in the system than others. Author

N68-16020# Congress. House. Committee on Science and Astronautics.

TECHNOLOGY ASSESSMENT SEMINAR

Washington GPO 1967 188 p Hearings Before Comm. on Sci. and Astronautics, 90th Congr., 1st Sess., 21–22 Sep. 1967

Statements before the Committee on Sciences and Astronautics regarding a procedure of technology assessment which may enable the Congress to integrate science and engineering into public policy and legislation on a more completely informed basis. Seminar participants include representatives from the natural sciences, humanities, social studies, and engineering disciplines. L.S.

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—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

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